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kilobaud™

The Small Computer Magazine

ISSUE #11 November 1977

Articles

Features

SWTPC announces first dual minifloppy kit under $1,000

Now SWTPC offers complete best-buy computer system with $995 dual minifloppy, $500 video terminal/monitor, $395 4K computer.

$995 MF-68 Dual Minifloppy
You need dual drives to get full benefits from a minifloppy. So we waited to offer a floppy until we could give you a dependable dual system at the right price.

The MF-68 is a complete top-quality minifloppy for your SWTPC Computer. The kit has controller, chassis, cover, power supply, cables, assembly instructions, two highly reliable Shugart drives, and a diskette with the Floppy Disk Operating System (FDOS) and disk BASIC. (A floppy is no better than its operating system, and the MF-68 has one of the best available.) An optional $850 MF-6X kit expands the system to four drives.

$500 Terminal/Monitor
The CT-64 terminal kit offers these premium features: 64-character lines, upper/lower case letters, switchable control character printing, word highlighting, full cursor control, 110-1200 Baud serial interface, and many others. Separately the CT-64 is $325, the 12 MHz CT-VM monitor $175.

$395 4K 6800 Computer
The SWTPC 6800 comes complete with 4K memory, serial interface, power supply, chassis, famous Motorola MIKBUG® mini-operating system in read-only memory (ROM), and the most complete documentation with any computer kit. Our growing software library includes 4K and 8K BASIC (cassettes $4.95 and $9.95; paper tape $10.00 and $20.00). Extra memory, $100/4K or $250/8K.

Other SWTPC peripherals include $250 PR-40 Alphanumeric Line Printer (40 characters/line, 5 x 7 dot matrix, 75 line/minute speed, compatible with our 6800 computer and MITS/IMSAI); $79.50 AC-30 Cassette Interface System (writes/reads Kansas City standard tapes, controls two recorders, usable with other computers); and other peripherals now and to come.

Enclosed is:

_____ $1,990 for the full system shown above (MF-68 Minifloppy, CT-64 Terminal with CT-VM Monitor).
_____ $995 for the Dual Minifloppy
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_____ $175 for the CT-VM Monitor
_____ $395 for the 4K 6800 Computer
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_____ $79.50 for AC-30 Cassette Interface
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_____ Additional 8K memory boards at $250
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PUBLISHER'S REMARKS

Wayne Green

Computermania

Though the attendance at Computermania was not up to my expectations, it was one of the largest microcomputer shows so far. The exhibitors were happy with the attendance, and the people who came to the show were happy with the exhibits. We'll do it again.

This was the first computer show to be widely advertised on radio, on television, in the newspapers and in business magazines . . . so it was the first show where a high percentage of the people were more interested in business uses than fun and games for microcomputers.

The conflict with PC-77 in Atlantic City was unfortunate as far as exhibitors were concerned, though it had little observable effect on the crowds attending Computermania. The record seems to be getting cloudy on this, so perhaps it is time to remind everyone that Computermania was the first show to announce for the August dates; PC-77 kept their selection of the same weekend a secret until *after* Computermania had been announced.

A curiously identical situation has developed with the *Personal Computing Magazine* show in Chicago in October and the show in New York, which was announced later by another magazine (also involved with PC-77). It is unfortunate that this infighting between magazines is going on.

Dick Brown, one of the owners of The Computer Store chain, giving a talk before a full house on how to open and operate a computer store.

Did Computermania Sell Stuff?

It varied. Firms depending on hobbyists for sales made ends meet, but were not overwhelmed. Firms selling to businessmen were overwhelmed. One dealer came away with sales leads for over 500 businessmen interested in systems. If only ten percent of those buy, that still means about $500,000 in sales – plus the chain letter effect when a businessman with a new microcomputer tells ten friends . . . etc.

Another dealer estimated over $200,000 in sales directly attributable to the show. The crowds? Dealers couldn't have handled more . . . they were kept busy every minute of the three days.

One barometer that I use is sales from the *Kilobaud* booth. With most hobbyists already getting *Kilobaud*, we've been finding the magazine subscriptions a little slow at recent shows. Computermania was the

Commodore's PET was difficult to get near – at any time!

Spreading out the booths is more expensive, but it leaves room to get around, even when there is a crowd.

The new Radio Shack microcomputer wowed 'em – drew nice crowds – made sales.

Dick Brown and Paul Connover of CCM (Consumer Computer Marketing) answer questions on how to start a computer store, how to finance it and how to keep it going. This session alone was worth the trip from anywhere in the world to Computermania.

biggest we've ever had, even though we made no serious effort to push the magazine at the show . . . our booth was toward the back and unadorned . . . with no special come-ons. Even so, sales were better than at PC-76 last year, when *Kilobaud* was first announced . . . about four times those at the Cleveland Computerfest, three times those at the Atlanta Computerfest and five times those at Seattle a few weeks ago.

Our gals handling the *Kilobaud* booth reported that the people attending the show were all excited about microcomputers and were looking for a magazine to help them learn more . . . obviously *Kilobaud* fits the bill best on this.

Al Smith of Adelco had quite a spread and found enough hobbyists present to make ends meet.

Here's Wayne with the proprietor of Jefftronics, Jeff, the youngest entrepreneur in the microcomputer field. Jeff is 16 and has his own company selling accessories, parts and gadgets for hobbyists. Look for Jeff at many of the computerfests.

The Channel 5 news team interviews Wayne. All major TV channels in Boston covered the show.

Heath – Radio Shack

The new systems by these firms are of great interest to all of us, so we'll be looking forward to reader reports on them . . . modifications . . . ways to adapt them to the Altair bus so we can start adding some of the hundreds of boards already available in that standard . . . etc. Any discussions on the pros and cons of the Radio Shack bus . . . the Heath bus vs the Altair bus will be of interest too.

Perhaps even more important will be programs for these systems – and remember that the more interesting and valuable programs may be put on cassette by *Kilobaud* and distributed through the stores to help with sales of systems. Royalties will be paid on all such sales . . . and they could mount up rapidly. This program-sale business has the possibilities of making far more money for software houses than they've ever dreamed of making from the old system of selling software. A number of them are already interested in the *Kilobaud* distribution plan . . . and several software houses have been formed recently just for the purpose of supplying well-documented programs for distribution.

We'll all be interested in any accessories designed for the Heath or Radio Shack computers . . . so keep me informed if you are going this route.

Home Protection

One of the most common suggestions for use of a microcomputer in the home is as a security system. The Digital Group features this as part of their exhibit at shows. Fine – but I'd like to see some articles on this application. Do we have to run a myriad of wires around the house, connected to every window and door, heat, smoke and movement sensors? Or what?

I think we could simplify our systems somewhat by applying supersonic techniques – like the remote television controls. Thus, you might be able to get away with one control system for each room and have each of the sensors send a small supersonic sound to the control, rather than having to have a bunch of wires all over the place. Or maybe you have a better idea?

If anyone can come up with a relatively simple system for keeping track of doors, windows, lights, movement, water, smoke,

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The Computermania T-shirts made a big hit with the Kilobaud *staff. Here are about half of the people who bring you this magazine every month. From left to right, back row: Wayne, Fran, Barbara, Aline, Laura, Bill, Marge, Elenor, Tobee, Lorraine, Steve, John, Tedd, West, Gary, Bob, Larry, Bob, Mike, Lynn, Mitch, Bob and Robin. Center row: John, Chris, Karen, Nancy, Pauline, Maureen, Alice, Sandy, Gayle, and Ray. First row: Dotty, Judy, Mary Jo, Barbie, Theresa, Sherry, Doni, and Judy.*

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EDITOR'S REMARKS

John Craig

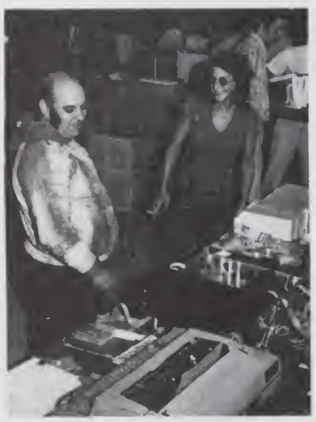
Magazines . . . and more magazines . . . . Do you know how many magazines there are in the personal computing field now? Would you believe an even dozen? Well, I'll list 'em for you: *Kilobaud, Byte, Interface Age, Dr. Dobb's Journal, SCCS Interface, Personal Computing, Creative Computing, ROM, People's Computers, Calculators & Computers, Computer Music Journal,* and *Computer Notes* (Mits).

In addition to all of those, we can find computer hobbyist articles in *73 Magazine* (when's the last time you saw the I/O section?), *Popular Electronics* and *Radio Electronics.* We even find that many computer trade journals (for the biggies) now have sections devoted to computer hobbyists (EDN, Datamation, Mini-Micro Systems, etc.). Needless to say, your pocketbook could get one hell of a strain if you tried to buy all, or even most, of these publications. But wait! There are even more!

Can you read Japanese? If so, run, don't walk, to the nearest post office and send off your check for 6000 yen (or $30) for a subscription to *ASCII* (305 HI TORIO, 5-6-4 Minami-Aoyama, Minato-KU, Tokyo 107, Japan). Real state-of-the-art material.

If you can read Australian (oops, make that English) then let me suggest you part with $A17.00 (that's 17 Australian dollars) for a subscription to *Electronics Australia.* Jamieson Rowe, the editor, has been writing and getting some really top-notch material on microcomputers. (*EA*, Sub Dept., John Fairfax & Sons, GPO Box 506, Sydney 2001.)

Last, but not least, we have England's entry in the field, *Practical Electronics.* They haven't had a heck of a lot on micros lately, but they'll hold a candle to *PE* and *RE* any day when it comes to electronic construction projects (*Practical Electronics*, Fleetway House, Farringdon St., London EC4A 4Ad).



Bob Mullen, of Mullen Computer Boards, came down from Hayward CA with a truckload of interesting wares, such as the Dura in the foreground, which went for an unbelievable price. He also had an eye-catching demo of his Relay/Opto-Isolator Controller Board, which, strangely enough, caused people to buy them. (Bob was telling me about a cross assembler for an 8080 that assembles code for a National SC/MP. I guess it was just a matter of time . . . but that's the first micro-to-micro cross assembler I've heard of.)

DataSync/Norman Hunt

Norman Henry Hunt, alias Col. David W. Winthrop, had two court appearances recently, one minor and one very major. The major one had to do with his arraignment and guilty plea to three counts of fraud. The district attorney dropped a count of of perjury and a count of misappropriation of funds, which occurred while Winthrop was head of DataSync. (Speaking of "the Colonel" . . . TDL ought to consider removing him from the "recommended by" portion of their ads.)

The second appearance was minor for him . . . and major for me. Several months ago he had rather craftily obtained my ASR-33. I got it back in a brief two-round small-claims court "battle." (They say you never really appreciate something until you've lost it. I will never part with that 33 again, believe me.)

While over in Santa Maria, I stopped by the offices of DataSync, and they proudly showed me their new baby, the DS-16K RAM II board. It was running without a hitch in their Imsai (they brought up Icom's FDOS as a demonstration). They should begin shipping within a few weeks. I hope so . . . I've got one on order. (By the way, this all took place on August 29th.)

Footnote: Many things are possible . . . if you want them bad enough. The folks at DataSync started from scratch designing that memory board on July 5th (Winthrop was arrested on July 1st). Fifty-six days later, they got the PC board

Bob Martin, famous software-type (vice-president) with Polymorphics Systems, is shown here doing his "eyes-closed" trick.

Jim Atwood, of Kathryn Atwood Enterprises (Orange CA), was in need of a throat lozenge at the end of the day. The price and design of his 4K memory board drew a lot of interest (and sales, I hope). We're going to have an article on interfacing his board to a KIM in an upcoming issue of KB.

Gene Christianson, of Alpha Data Systems in Santa Barbara, has developed some of the most significant small-business software (with North Star BASIC) that I've seen in some time. He was demonstrating his latest: a cash register/inventory control program.

back from the manufacturer, stuffed the board, plugged it in . . . and fired it up! Hell, I guess if a farm boy named Luke Skywalker can suddenly, without any apparent training, become an ace starship fighter pilot then anything is possible, right? (May the Force be with you.)

Plugs

I've recently racked up a list of places where I'm going to be giving talks in the future . . . and thought I'd give them (and me) a plug.

The subject will be "Introduction to Microprocessors" at the Southwestern Division 1977 ARRL Convention in Santa Maria CA, October 7th, 8th and 9th. I sure hope I can convert a number of those hams over to computers.

Second on the agenda is the IEEE COMPCON (Spring 1978), which will be held in San Francisco from February 28th to March 2nd. They will have a personal computing session, to be moderated by Dennis Allison of *People's Computers.*

Finally, I'm going to be teaching a one-day course on personal computing at the University of California at Santa Barbara on Saturday, February 25th, 1978. Boy, am I looking forward to that!

Dr. Ed Reilley's table is typical of the many non-commercial sellers with gobs and gobs of miscellaneous goodies that make swap meets so much fun!

The California Happening

While the rest of the country was busy getting ready to take off for Boston and Atlantic City, we had our own little shindig out here in California . . . a swap meet. Last December I organized a local swap meet for computer hobbyists, hams and electronic experimenters in the central California area. There was such a response, and folks had such a good time, that I decided to do another, and even bigger one, in August. This one was a statewide event . . . and just as much fun! It all took place on August 20th in Beautiful Downtown Lompoc, the flower capital of the world. We had sellers come from as far east as Denver, as far north as San Francisco and as far south as San Diego.

I think anytime a bunch of people with common interests get together you'll find a good time. That's one of the reasons I enjoy putting together something like this . . . it's really just an excuse for a get-together. Needless to say, it's also a great opportunity to find that little something you've been wanting or that something you'll probably never need . . . but you buy anyway!

I'm going to do it again. This time it will be a two-man effort, however. Art Childs (the ex-editor of *SCCS Interface*) and I are organizing the Third Semi-annual Hobbyist Swap Meet for December 10th, 1977. This time, we'll be moving south to the big city in the San Fernando Valley (doesn't that sound better than saying, Los Angeles?). Mark your calendars . . . December 10th. Details will follow next month.

The sellers who traveled to Lompoc brought some fascinating goodies, but, without a doubt, one of the highlights of the event was

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That's Hal Singer, editor of the famed Micro-8 Newsletter, *on the left getting ready to open his pocketbook for Larry Page of Page Digital Electronics (Pasadena CA).*

I managed to get Roger Simpson, of Computer Electronics in Santa Barbara, before the onrush of the crowds.

Vandenberg Data Products, and their new 16K memory board, were represented by the company's founder and president, Nelson Henderson. Nelson's entire family was there, including his wife Barbara (on the right), who wrote "Computer Widow" in issue No. 1 of Kilobaud.

Even yours truly managed to crack the ol' pocketbook (once too often, actually).

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NEW H8 8-Bit Digital Computer. This 8-bit computer based on the famous 8080A microprocessor features a Heathkit exclusive "intelligent" front panel with octal data entry and control, 9-digit readout, a built-in bootstrap for one-button program loading, and a heavy-duty power supply with power enough for plenty of memory and interface expansion capability. It's easier and faster to use than other personal computers and it's priced low enough for any budget.

NEW H11 16-bit Digital Computer. The most sophisticated and versatile personal computer available today — brought to you by Heath Company and Digital Equipment Corporation, the world leader in minicomputer systems. Powerful features include DEC's 16-bit LSI-11 CPU, 4096 x 16 read/write MOS memory expandable to 20K (32K potential), priority interrupt, DMA operation and more. PDP-11 systems software for fast and efficient operation is included!

NEW H9 Video Terminal. A full ASCII terminal featuring a bright 12″ CRT, long and short-form display, full 80-character lines, all standard serial interfacing, plus a fully wired and tested control board. Has autoscrolling, full-page or line-erase modes, a transmit page function and a plot mode for simple curves and graphs.

NEW H10 Paper Tape Reader/Punch. Complete mass storage peripheral uses low-cost paper tape. Features solid-state reader with stepper motor drive, totally independent punch and reader and a copy mode for fast, easy tape duplication. Reads up to 50 characters per second, punches up to 10 characters per second.

Other Heathkit computer products include a cassette recorder/player and tape for mass storage, **LA36 DEC Writer II keyboard printer terminal,** serial and parallel interfaces, software, memory expansion and I/O cards, and a complete library of the latest computer books. The Heath User's Group (HUG) provides a newsletter, software library and lots more to help you get the greatest potential from your Heathkit computer products. We've got everything you need to make Heath your personal computing headquarters, send for your FREE catalog today!

NEW PRODUCTS

OSI Challenger III

The Ohio Scientific Challenger III contains a new triple-processor CPU board that can run virtually all published software available today for microprocessors at a very small cost increase over comparable single-processor computers. Equipped with three microprocessors, Challenger III runs 6800, 6502, 8080 and Z-80 programs.

Challenger III comes standard with the OS-65D Disk Operating System and is ideal for educational applications. Students can study the three microprocessors for programming and engineering analysis.

Disk Operating System comes standard with OSI Challenger III.

Small business application is an ideal use for the Challenger III. Businessmen can utilize software packages written for any of the three microprocessors while conducting everyday business functions on the computer.

Industrial development is another area where Challenger III can be utilized for the investigation and comparison of the three processors. A 74-megabyte disk option makes mass data storage a reality for the experienced user.

Still another application of the Challenger III is for personal computing. The personal computing enthusiast can experiment with the three processors to no limit with software programs of all three types. Personal finances, strategic games, home and business applications are just a few of the Challenger III applications.

For advanced users, a software processor status switch is available so that multiple processor programs can be written. This option also includes a one megabyte pager and user-programmable vectors for both the 6502 and 6800 allowing real-time multitasking operation.

Challenger III is fully compatible with all Challenger hardware and software, and is available from Ohio Scientific, 11681 Hayden, Hiram OH 44234.

New Heathkit Catalog

The latest Heathkit catalog lists nearly 400 electronic products in kit form, plus a variety of Heath-recommended assembled electronic products.

Among the new kit products in the catalog are: an entire line of personal computer systems, including software and peripherals, an active audio signal processor to enhance the performance of most hi-fi systems, a digital electronic scale for the home, and new test equipment including an FET multimeter and oscilloscope.

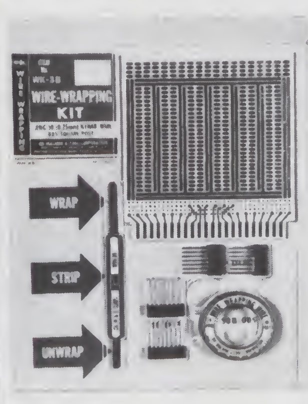
New Fall catalog from Heath.

Heath-recommended assembled products include a microcomputer-based electronic chess game, a videocassette recorder, telephone answerer/recorder, two new cassette recorders and an electronic indoor greenhouse.

The catalog also describes other kit form and assembled products, including automotive and marine accessories, amateur radio equipment and a computerized, digital, programmable color TV. The catalog is available free from Heath Company, Dept. 350420, Benton Harbor MI 49022.

Wire-Wrapping Kit

OK's new wire-wrapping kit features selected items



OK Machine and Tool's new wire-wrapping kit.

of particular value to the prototype engineer and hobbyist. The kit includes a unique new wire-wrapping tool, a 50 ft. (15m) roll of wire, two 14-pin dip sockets and two 16-pin dip sockets. Specially featured is a new high-quality PC board Model H-PCB-1.

The tool, model WSU-30, wraps and unwraps 30 AWG (0,25mm) wire on .025 (0,63mm) square pins, and has a built-in stripper. The wire is top-quality Kynar insulated silver-plated copper. The H-PCB-1 is the first in a new series of top quality PC boards and has 22/22 edge-connector contacts on standard .156 spacing. The kit (Model WK-3B) is $15.95.

Also available is the finest industrial-quality AWG 30 (0,25mm) wire on compact, convenient 50 ft. (15m) rolls. The wire, silver-plated OFHC copper with Kynar insulation, combines excellent electrical and mechanical characteristics with easy strippability, and is available in four colors: red, white, blue and yellow. OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.

Radio Shack TRS-80 Microcomputer System

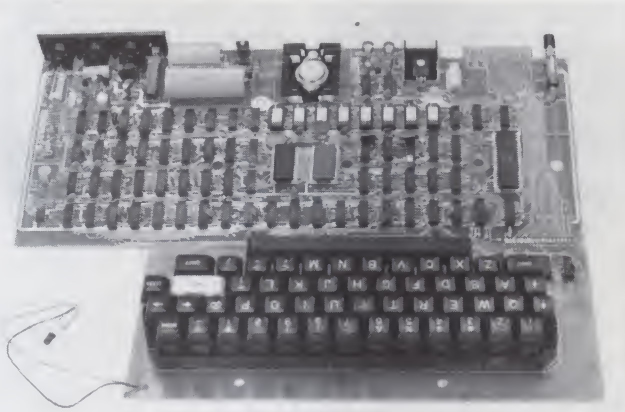
Radio Shack has just introduced their new TRS-80 Microcomputer System. Not a kit, the TRS-80 comes completely wired and tested, ready to plug in and use.

The TRS-80 System consists of a 53-key professional-type keyboard and microcomputer plus regulated power supply, a data cassette recorder, which is computer controlled through an interface, and a 12 inch video display monitor.

A comprehensive owner's manual that explains everything necessary for its operation from plugging it in through programming is supplied with the TRS-80.

Radio Shack will also supply prerecorded cassette programs for such applica-

TRS-80 Microcomputer System.



Keyboard and main PC board for Radio Shack's TRS-80 Microcomputer.

tions as a small-business payroll, general ledger accounting, accounts receivable and inventory control.

For educational purposes, the microcomputer can be used to teach mathematics, music theory and virtually any subject through programmed teaching methods.

Just for fun, a variety of game programs will be available, including blackjack and backgammon. Other home uses are personal finance management, storage of recipes, menu planning and message center.

Provisions have been made in the TRS-80 for later addition of accessory or peripheral items such as an additional tape recorder, disk programming and a printer, which would create a permanent, typed record of the computer output.

At the heart of the Radio Shack TRS-80 Microcomputer System is a Z-80 microprocessor chip, which serves as the central processing unit, or "brain," of the microcomputer. This remarkable device, about the size of a watermelon seed, is one of the more advanced microprocessor chips available today.

The TRS-80 Microcomputer System is priced at $599.95, complete with video display monitor and data cassette recorder. The microcomputer alone will sell for $399.95.

Microcomputer Desk

A desk specifically designed to house a personal or business microcomputer system is now available from Computer Systems Design. The Microdesk can be easily assembled without tools in five minutes. The desk is constructed of high-density vinyl-clad board and measures 48 by 24 by 28 inches. A sliding shelf at convenient typing height is provided for a keyboard. Also included for equipment and books are two shelves, one of which is adjustable. Additional shelves or rails for rack-mounted equipment are available as options. The Microdesk is available for $96.50, FOB Wichita, from Computer Systems Design, 1611 E. Central, Wichita KS 67214.

The Microdesk in use.

TLF Data 12 Is PDP-8E Compatible

The Data 12 is a complete, self-contained 12-bit microcomputer with an integral 262,000 word random-access tape drive. In addition to executing the instruction set of the Digital Equipment Corporation PDP-8E minicomputer, it also has instructions for floating-point decimal arithmetic, numeric and character string input and output, block memory move and search, and push-pop instructions for recursive subroutine handling.

Fully assembled, the system sells for $1695 – including 4096 words of user memory, serial terminal interface, tape controller with one drive and a comprehensive tape-operating system that includes both an unattended batch mode of operation and real-time task scheduling capability.

The random-access tape drive uses a preformatted digital cassette, and has an average access time of less than 25 seconds with bidirectional search speeds of over 100 inches per second.

The software supplied with the system is completely keyboard oriented. It includes an invisible system executive that handles all input/output scheduling, buffering and vectoring. It can intercept I/O from any standard peripheral device, and route it to any other device. As an example, this allows software written for a paper-tape system to operate to/from the system files without any modification.

Two high-level languages are included with the Data 12 – extended BASIC and PHOCAL. The BASIC used is a true compiler giving very fast execution times, and will execute a program approximately 6000 characters (about 300 lines) long in 4K of memory. It can save and recall named programs from the system tape, has a "chain" statement for linking programs to an almost unlimited length, has multidimensioned arrays, string handling, multiple statements per line, and allows up to 26 multiline user-defined functions.

PHOCAL is a versatile, FORTRAN-like language with an optional immediate mode of operation. It can

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TLF Data 12 with built-in mass storage.

THE BASIC FORUM

John Arnold/Dick Whipple

Letters to the BASIC Forum are beginning to reach us at a more regular pace. In fact, we are seeing a small backlog start to develop. Lots of interesting comments have come our way, and we want to give as many as possible the "floor at the Forum."

Let's take the letters this month in roughly the order of Forum columns to which each refers. Comments are still being received concerning the issue of BASIC language standardization; commenting readers tend to address the problem from two different points of view. Those with a background in programming see standardization as a conceptual stepping-stone to assure the future success of BASIC as a general-purpose computer language. Comments from newcomers to computing take standardization as a matter of great practical importance – they have a new hobby computer and want it to do something interesting, if not tremendously useful. The differences between BASICs tend to make entering programs from available books and magazines a difficult task for those without wide experience with the language. Letters in past columns have reflected both points of view. This month we offer two more. The first comes from Clive Grant, Airport Road, R.F.D. #3, Laconia NH 03246. Although Clive must be classified with the experienced group, he takes a somewhat different stand on the issue of standardization.

"Before the days when trigonometric functions were available by specifying the function, and before the days when something as simple as finding a square root required a decision to be taken about the optimum algorithm to employ, I started writing computer programs. (My first paid assignment was an application of the solution of oblique triangles. Try that with only addition and subtraction available!)

"I learned ALGOL in 1952 and BASIC a dozen or so years later. In between, and since, I have used a variety of languages. None is perfect. However, for the type of interactive programming that the majority of hobbyists will probably write, BASIC is a wise choice. It is as powerful as the majority will ever require. Moreover, BASIC may be learned by even those with the most extreme anthropomorphic view of computers (what we, here, call 'suffering from a terminal illness.')

"I am probably not qualified to enter a discussion comparing computer languages. My interests, personally, are in applying numerical techniques and, commercially, in deriving a profit from those applications. There may be a universally applicable, logically consistent computer language, but, in another context, if I were an author I would not be too excited by offers to translate my works into Esperanto" (Webster's New World Dictionary defines Esperanto as: "an artificial language for international [chiefly European] use, based on word bases common to the main European languages").

Our next letter comes from a newcomer to computers and BASIC. Jim Faliveno, Box 56, Cherry Valley NY 13320, was introduced to computing through his interest in ham radio and *73 Magazine*. Although you will note that his comments refer specifically to one manufacturer's BASIC, the problem extends to all versions currently available to the hobbyist. Let's hear from Jim and then we will have more to say . . . .

"I didn't realize how using uppercase only has affected my typing till now. Vive la computer!

"I read the BASIC Forum with great interest and wish it would come out more often. I'm sure you're working on it.

"Something new happened to me this year . . . a computer came into my life. Being involved with ham radio, I was introduced to this subject by *73 Magazine*, and the interest turned into a passion till I ordered a Digital Group Z-80. I expanded it until it now has 26K, and two Phi-decks are on order. I have thoroughly enjoyed building it and getting it to work, but I knew from the beginning that the "software" part wasn't going to be easy. But boy! I didn't expect what is happening to me to happen as it has. While I was building up to the 26K and using Tiny BASIC, I kept dreaming of the day when I could run full BASIC (what with delivery on the 8K boards, etc., it took from January to May to get it all together). Finally, the bugs out, I loaded Maxi-BASIC . . . READY . . . (I purchased *101 Computer Games*. I figure I'll see how they write a program and steal a little from this and a lot from that and surely I'll be able to write my own.)

"The program DIAMOND is my first choice. After typing it all in, it doesn't run . . . CONTROL STACK ERROR nn. So I tape it and try another called BOAT. No run. *&%@!! Looking through the listing, Maxi-BASIC doesn't have an ARC TAN. It doesn't even have a TAN! Well, I'll be! Then something useful comes up. *Kilobaud* prints a pass-the-buck program. I load it, and guess what? No string arrays! Now come on! I've got all this money tied up in this and I can't run what I want?

Well, I bought some books on BASIC and have done a lot of reading, and I'm convinced that somehow a standard has to be established somewhere. Imagine ham radio today if everyone had his own version of Morse code! BASIC is what we compute and communicate with. Now every ham has his own type of equipment, his own method of building antennas, feed lines, etc. But, we all speak English, use the same Morse code, work in the same frequency bands and use the same conventions (taking turns, courtesy, etc.). But try to speak French on the ham bands, and you've just come up with an automatic scrambler. Why does it have to be this way with BASIC? Why doesn't my computer speak the same languages as yours. Sure, there is room for dialects and accents, but shouldn't the language I run essentially be able to do the same as yours?

"This is the same thing a language interpreter runs into when there is no English translation of the word. My BASIC doesn't have an ARC TAN . . . *or a* TAN, $(12), MID$, MAT and who knows what else I haven't discovered yet. And, worse yet – *I don't know what to do about it.* I know the Z-80 is capable, but I'm not a programmer or an expert in machine codes. I'm a *hobbyist . . . amateur . . . I don't know anything . . . I'm learning.* Where do I go? There are no books that address this problem. The manufacturers seem to be enjoying this confusion. My instruction manual presumes I have a knowledge of BASIC. Well, now, I do, but my BASIC doesn't have what their BASIC has. Somewhere, there have to be some answers.

"The Forum in issue No. 4 was great. It was the only place I got a good understanding of CHR$, STR$, and got an idea of what MID$ is all about, even though I don't have it (wish I did). I appreciate your efforts.

"Don't get me wrong. I've talked with Chuck and Dianne at DGSS, and

they're real nice people; but I've got a lot of hardware here that is doing nothing at the moment and won't run the program of my choice . . . and that is making me MAD (not the language).

"I would like to suggest that you and *Kilobaud* get together and establish a category system for rating BASICs. Words like 'full BASIC' are meaningless. For example, Category 1 BASIC has the fundamental commands. Category 2 has the Category 1 commands plus these extras. Category 3 has Category 1 and 2 plus these additional commands. Extended BASIC, Maxi-BASIC, Tiny BASIC and all this is for the birds. Set the standard, publish it, republish it, say it long and loud enough, and people will start to believe it. When that happens, you will find the manufacturers claiming they have the *only* Category 6 BASIC plus these functions available. The terms 8K, 12K and whatever version of BASIC aren't any good anymore. Memory is now cheap! Performance is now important! My memory was scrounged. It is better than 450 ns, and all 26K cost me $150 for the boards and sockets, and a total of $107.50 for the chips. What do I care if my BASIC takes up 12K, 13K, 15K?

"Thanks for letting me beat back your ears. Keep up the good work in your column."

Jim has touched (perhaps "crashed into" is more like it!) one of the practical realities of this newest of hobbies. Before anyone gets the idea that Maxi-BASIC is the culprit in Jim's problem, let's look at the situation more closely. Jim picks up a copy of *101 Computer Games* — a very natural thing for a new computer hobbyist to do. It is full of interesting games, but here's the catch: It was written on Digital Equipment Corporation machines in DEC's version of BASIC. Even if Jim had had Mits BASIC to start with, he would have had difficulty translating some statements. Neither he nor anyone else could have simply sat down and entered the program line by line and gotten it to work. Now, admittedly, an experienced BASIC programmer could have studied the differences and rewritten the program where necessary.

A similar situation would have arisen if Jim had bought PCC's nice game book, *What To Do After You Hit Return*. It was written in Hewlett-Packard BASIC — again not a one-for-one equivalent of DEC, Maxi-BASIC, Mits or any other. An experienced programmer could probably make the necessary changes, but what about other folks who are just looking for a way to get their new toy to do something — anything. The only answer to that question is, "Dig it out for yourself." We would like to say, buy such-and-such a book on BASIC, but we don't know one that covers DEC, HP, DG, Mits . . . all under the same cover. Our best advice is to buy a good book, sit down at your machine and start hacking away — that's about the only way we know.

We should point out that there are limitations in some BASICs that are difficult to overcome even in the hands of an experienced user. For instance, the absence of string arrays may require substantial revision or a complete rewriting of a given program. As another example, recall a couple of months back when we mentioned chaining of programs in disk BASIC (permitting one program to load and execute still another program on disk). Jim Drebert, 2447 Alvin St., Mt. View CA 94043, called to tell us that his disk BASIC just didn't have provision for chaining programs. He needed it for his business package, but it just couldn't be done. We could take each version in turn and discuss specific limitations and it still would not solve all the problems associated with converting a program in BASIC X to make it run in BASIC Y. The confusion is real and it is beginning to gnaw at our readers and us as well.

```
100 PRINT "WHAT IS 2 + 2"
200 INPUT (5,400)A$
300 IF A$="4"
. . . .
400 REM HERE IS PROMPT IF DELAY EXCEEDS
    REM 5 SECONDS
```

Example 1.

```
10 INPUT A1,A2,A3,A4,A5
15 INPUT B1,B2,B3,B4,B5
20 INPUT C1,C2,C3,C4,C5
25 INPUT D1,D2,D3,D4,D5
30 INPUT E1,E2,E3,E4,E5
35 S1=A1+A2+A3+A4+A5
40 S2=B1+B2+B3+B4+B5
45 S3=C1+C2+C3+C4+C5
50 S4=D1+D2+D3+D4+D5
55 S5=E1+E2+E3+E4+E5
60 AVERG=(S1+S2+S3+S4+S5)/25
65 PRINT AVERG
70 GOTO 10
```

Example 2.

```
 10 COUNT = 0
 15 SUM = 0
 20 READ GRADE
 25 IF GRADE <0 THEN 45
 30 SUM = SUM+GRADE              Iterative
 35 LET COUNT = COUNT+1          calculations
 40 GOTO 20
 45 AVERG = SUM/COUNT
 50 PRINT AVERG
100 DATA 98,80,92,88,75,60
110 DATA 100,94,95,85,92,98
120 DATA -1
```

Example 3.

Jim's idea of a classification system seems a good thing to consider. We have talked about this before and plan to look into it further. We have thought of devising a questionnaire to send to each BASIC supplier. Based on the results, we would classify the available versions and at the same time attempt to establish an overall picture of what the standards should be. It would be self-defeating to submit questions that are tied closely to the syntactical structure of one current BASIC. For instance, we should not ask if the version has, say, the STR$ function. We should ask the more general question: Does your BASIC permit conversion of numeric values to character strings? Only in this way can we really get a proper overview of the BASIC language's capability as it is today. Let's have some comments to the Forum. If this idea has merit, we would like to pursue it; if not, we will let it drop by the wayside.

In a previous Forum, we included some letters with ideas for new BASIC statements. Two additional notes have come to us recently, which we will now insert in the data stream.

David Schwan, 1629 Gary Grove, Quincy IL 62301, writes: "In reply to your asking for new BASIC functions *(statements)*, *I* would like to recommend the following: ARC COS and ARC SIN. At the present I have yet to see a BASIC compiler used on a mini that has these functions. They are indispensable for engineering and scientific work. Both can be generated through the use of a series. At the present I'm building an OSI 400, and when I get their BASIC running in my system, I'll send *Kilobaud* the source listings for the above func-

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LEGAL/BUSINESS FORUM

Kenneth S. Widelitz
Attorney at Law

First, a few housekeeping matters. The long lead time necessary for writing a column of this nature makes for slow reactions to reader response. It was pointed out to me that in the first Legal/Business Forum (August 1977), in discussing the mail-order laws, I failed to include the address of the Federal Trade Commission. Write to: Director, Bureau of Consumer Protection (MO-P), Federal Trade Commission, Washington, D.C. 20580. You should include a copy of the advertisement if it states a promised delivery date and a copy of your canceled check with your complaint.

One other cleanup item. The cutoff date for retailers wishing to become founding members of the Computer Retailers Association has been moved up to November 15, 1977.

Should Copyright Protect Computer Programs?

That is the question addressed by the software subcommittee of the National Commission on New Technological Uses of Copyrighted Works (CONTU). That subcommittee's latest report, issued in June 1977, concludes that the answer should be yes. The report, available from CONTU, Washington, D.C., 20558, telephone (202) 557-0996, makes for some interesting reading, as does the report of the data base subcommittee. Those reports, if adopted by the full CONTU commission, will be submitted to Congress and form the basis for additions to or changes in the Copyright Law.

Congress has recently made substantial changes in the Copyright Law to be effective January 1, 1978. However, in so doing, Congress explicity recognized that questions surrounding the protection of software required a more extensive review. CONTU was charged with conducting such a review.

I'm not going to get into the nuts and bolts of the new law or discuss copyright in detail. I am going to discuss some of the philosophical issues raised by the CONTU Software Subcommittee report and the dissent that accompanies it.

The report first sets forth its goals: how to balance traditional individual and societal interests that conflict. Those interests include the broad dissemination of works so as to benefit society, the ability of authors to make a living from their efforts and the protection of works of authorship against misappropriation. Concerning the latter, there currently exist three potential vehicles for protection: copyright, patent and trade secrecy. There have been additional proposals, most of which are, in reality, hybrids.

A brief discussion of the three existing vehicles is in order. As the software subcommittee report states, "...copyright is designed to protect the expression of ideas while patent's purpose is to protect what are generally understood to be inventions – in a sense the ideas themselves." To be eligible for patent, an invention must be useful, novel and not obvious to those familiar with the related technology. Copyright does not look to the quality of the work, but rather its originality. The independent creation of a work identical to a preexisting work does not infringe the copyright of the prior work. Under the patent system, the independent development of the same work is termed infringement.

Trade secrecy involves protection by exacting contractual promises that the "idea" to be revealed by an entrepreneur to his customers will not be further communicated. Obviously, trade secrecy does not lend itself to the broad dissemination and interchange of information. It is also easy to lose, not only through laxity on the part of its owner, but also when a lawsuit for breach of the Trade Secrecy Agreement is brought. The record of the trial renders the "secret" public.

The following excerpts from the subcommittee report go to the meat of the issue and will give you a good taste of the report's flavor.

"In discussing computer programs, attempts are often made to explicate various problems by the use of analogies in which the statement 'computer programs are more or less like ...' is frequently used .... Programs, unfortunately or otherwise, are 'like' little else. They are, however, writings which set forth instructions or sets of instructions. As simple as this sounds, it bears emphasis: They are not 'like' books, paintings or television sets. They are instructions fixed in a tangible form of expression ....

"A computer program is a writing that sets forth instructions that can direct the operation of an automatic system capable of storing, processing, retreiving [sic] or transferring information. It is an explanation of a process and not the process itself. This distinction between the process and the writing that describes it is of critical importance to understanding how copyright applies to computer programs. With a computer program as with all forms of creative endeavor, there are three different phenomena:

1. A description of the activity (process);
2. The activity (process) itself; and
3. The results of the activity (process).

"Descriptions of a process are protectable through copyright without regard to whether they are narrative descriptions or lists of instructions. Processes or principles of operation – indicated by the second category – are protectable, if at all, through patents or trade secrecy .... At all events, the program is not the process itself but is a writing that sets forth a set of instructions permitting the process to occur."

The last statement is the critical one. In an excellently written dissent, John Hersey points out a technical fallacy in the software subcommittee's thinking. He states, "... the computer program is something strikingly new in our culture. Something which is, at different times, both a writing and a mechanical device."

How is this so? Hersey states, "In the case of computer programs, the *instructions themselves* become an essential part of the machinery that produces the results. They may become (in chip or hard wire form) a permanent part of the actual machinery; or they may become interchangeable parts, or tools, insertable and removable from the machine. In whatever material form, the object phase of the program enters into the mechanical process. The former language of the instructions is converted into a device commanding a series of electrical impulses which – to use a slightly inexact layman's image – set and operate the switches of the computer in such order as to produce the desired re-

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THE KIM FORUM

Rick Simpson

KIM is having an identity crisis. Is it just a very good system for the microcomputer novice? Or does it have the capability to compete with the "big boys" as a full-blown microcomputer *system?* Can a small board designed to familiarize the engineer with the MCS6502 microprocessor grow up to be a real computer? Is putting a floppy disk on a KIM like attaching water skis to a canoe? Where, in short, do we go from here?

My visit to the MACC convention in Cleveland in mid-June let me witness a variety of ways people are trying to answer these basic questions about KIM. I went to the show to see if users were seriously interested in large-scale software for KIM. I didn't expect a huge response since KIM systems with 8K or more of memory are still pretty rare. I shared a booth with Eric Rehnke, editor of the *KIM User Group Newsletter.* There were plenty of visitors to the show, and the exhibitors represented most of the larger computer stores in the Midwest. When I decided to attend, I never dreamed that the KIM would be one of the most widely represented systems at the show, but it was. Seven of the 40 booths in the show had one or more KIMs on display (there wasn't an Altair to be seen!).

One of the most ambitious offerings was at the Riverside Electronics booth, where they were showing a KIM-1 mated to a motherboard of their own design. Their board accepted Altair modules, their own video interface board, and had sockets for several 2708 EROMs, as well as several K of RAM. They should be delivering by the time you read this.

Newman Computer Exchange, of Ann Arbor MI, was showing the KIMSI motherboard for the KIM-1, which also accepts Altair modules; and Johnson Computing was exhibiting both KIM and the new OSI system, which is 6502-based. Johnson was also taking orders for Commodore Business Machines' new PET computer for delivery in late fall.

United Microsystems has come up with an ingenious answer to the perennial question, "How do I package a KIM when I build a system around it?" Their KIM-ALPHA is a molded plastic case, which looks like a computer terminal, complete with full keyboard and integral video monitor. Inside are a KIM-1, expanded memory and video interface.

Newman Computer was also showing a "barefoot" KIM running Peter Jennings' MICROCHESS – still the best program I know of to convince people who've spent four times the price of a KIM-1 on a larger system that they may have made a mistake in brushing off KIM as "too basic to do anything really complex."

From my point of view, the most fascinating use of KIM was in a noncommercial booth – that of SEMCO, the Southeast Michigan Computer Organization. SEMCO will host the next MACC convention June 23-25 at the Detroit Plaza Hotel. SEMCO is obviously a hotbed of KIM activity – they purchased a copy of FOCAL at the show, had it up and running in about fifteen minutes and loved it so much they took it up to their room to play with it all evening. Rene Vega showed me some of the software they've written for their KIMs. It included a cassette operating system and the start of a full operating system for KIM. They had also written an excellent keyboard-video RAM monitor, which had the game of LIFE implemented as well.

A Different Kind of "Software"

Eric Rehnke, Stan Ockers and Jim Butterfield have gathered their considerable KIM experience together and produced *The First Book of KIM* ($9 from ORB, P.O. Box 311, Argonne IL 60439). Eric needs no introduction; Stan is best known for his "Hunt the Wumpus" program for KIM, and Jim has produced an endless stream of games and utility programs for KIM, including the "Supertape" routines. (See Jim's article on "Hypertape" on page 66.) They describe the book as "a collection of dozens of programs – some useful, some recreational, all tested and documented . . . . Also included is a beginner's guide and other information useful to current and prospective KIM owners."

As a sneak preview, I'll also mention that Caxton Foster of the Computer and Information Science Dept. at the University of Massachusetts is the author of a college textbook for use in microprocessor-oriented classes. All programming examples use KIM. This should be a natural for the many colleges that now use KIM in their computer science curriculum. The book should be ready by next spring.

A Case for KIM!

Another KIM problem has been solved. The Enclosure Group, 55 Stevenson St., San Francisco CA 94105, has come out with a very neat enclosure for a "naked" KIM-1. Their solution makes KIM look like an oversize calculator, with cutouts in the side for the two connectors. There doesn't appear to be room inside for a power supply or any expansion boards. The case comes in a choice of four colors and costs $24.95. When you order, tell them whether your KIM has its single-step switch on the right or left side of the keypad since MOS has used two different keypads and each requires slightly different cutouts.

A User Comments on a KIMath Problem

"I am writing concerning an error in the KIMath routines. The routine USTRES (FEBA) is supposed to unpack the RZ register and store the results at address specified by (RES, RES+1). The routine actually leaves an empty cell between the last ASCII digit of the mantissa and the first digit of the exponent.

This is caused by using the INY instruction at FED1. The Y index is correctly positioned by the INY instructions at FEC1, but once all digits of the mantissa have been moved the Y index is incremented *twice.* This points the index to one cell past the end of the mantissa." (John Eaton, Vincennes IN)

PET vs KIM

Unless this is the first issue of a personal-computing magazine you've ever looked at, you must have heard about Commodore's (MOS Technology's parent company) PET personal computer (even though Commodore has never run an ad for it anywhere!). The PET has a built-in video monitor, keyboard, cassette drive and BASIC, and an operating system in 13K of

ROM (yes, 13K!). It also includes 4K of RAM and is expected to retail for $598. I'm often asked, "Should I buy a KIM now or wait for the PET?" The answer, as usual, depends. If you have $600 to spend all at once, only want to work in BASIC and want to do your interfacing, if any, through the IEEE-488 bus structure *and* are willing to wait till after Christmas (yes, they'll be introduced around November, but the supply will be mighty short), then perhaps the PET is for you. If you want to expand your system modularly, get your system in a month, use BASIC, FOCAL, or assembly language, depending on the job to be done, and start with an investment of $250, then KIM may be better for you.

My final observation on this subject is that most owners seem to enjoy seeing how far they can stretch the capabilities of their KIM. Every one I've seen seems to have some user-supplied (and often user-designed) circuitry trailing behind it. LEDs, speakers, A/D converters, relays, all seem to gravitate to KIM, and there is no doubt that the built-in timers, keypad, and I/O lines encourage these efforts. What have you put on your KIM?

User Comment on KIM-1 Cassette Tape PLL Adjustment

"The statement 'This adjustment has been factory preset and should only require adjustment due to component replacement,' in reference to the KIM-1 PLL free-running frequency is *not correct!* In less than a year's time, and on at least two occasions, I have had to readjust the VR1-5K trimmer pot in order for the cassette interface to work at all! Both failures were due to a change in humidity or temperature-pressure when the interface went from an air-conditioned environment to either a low-pressure, very dry condition, or to a moist muggy-hot atmosphere in field use of KIM.

"The low-quality 5K carbon-paper composition trimmer pot is the source of difficulty here. The resistance value may change as much as ten percent for a humidity change of 60 to 95 percent, and similarly the temperature coefficient of this type of cheap carbon trimmer can be as high as 2000 ppm/°C. Use of a better-quality metal film or carbon film trimmer here would undoubtedly reduce the number of factory service requests for those who are timid and heed the warning on page E-2 of the *KIM-1 User Manual.*

"Adjustment of the VR1 pot is actually rather easy. A jumper is connected between pins A-P and A-L. A test monitor program located at address 1A6B is initiated and a dc voltmeter connected from pin E-X (PLL test) to ground. The VOM should read between 0.7 and +3.0 V when VR1 is properly adjusted. A reading of zero or +5 V is incorrect and usually indicates the center frequency is off for proper tracking of the PLL on playback. I try to trim this to about +1.4 V for best operation; however, the adjustment is very critical relative to the rotation of the trimmer pot. The very smallest turning of the trimmer produces a big change in the threshold adjustment – again indicating that a better quality potentiometer would make life much easier for the KIM-1 user." (R. W. Burhans, E. E. Dept., Ohio University, Athens OH)

At Long Last – 8K BASIC

I mentioned that BASIC is now available for KIM. Following close on the heels of the BASIC for OSI systems, Johnson Computers, 123 W. Washington St., Medina OH 44256, has announced the availability of a version of the famous Micro-Soft BASIC specially configured for KIM. Once again, the 6502 is proved to be one of the fastest processors available; BASIC on KIM runs faster than any BASIC reported in the recent *Kilobaud* benchmark tests, beaten only by the integer BASIC running on the APPLE I – another 6502-based machine. Take that, Z-80 owners!

Preliminary information states that the BASIC is available on KIM cassettes

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AROUND THE INDUSTRY

John Craig

Isaacson Nominated to Chair Store Owners' Association Committee

Dallas TX – Portia Isaacson, vice-president of Binary Systems Corporation, was nominated June 17 to be chairperson of a committee to form the first national association of independent computer store owners.

The initial exploratory meeting of some 40 store owners was held in Dallas at the National Computer Conference convention.

In addition to Dr. Isaacson, who represented the Dallas area Micro Stores, which are retail affiliates of Binary Systems, Inc., others elected to the committee included: Ray Borrill, the Data Domain, Bloomington IN; Dick Heiser, the Computer Store, Santa Monica CA; Larry Stein, Computer Mart of New Jersey, Iselin NJ; Joseph Kappl, Byte Shop of Thousand Oaks, Thousand Oaks CA; Hollis Rogers, Computers Etc., Houston, TX; Cary Fitch, The Computer Store of Jacksonville, Jacksonville, FL; and Sam Knecht, Computer Systems Design, Wichita, KS.

An organizational plan covering bylaws, goals, services and budgetary considerations for the association, which will be known as the "Computer Retailer's Association," was presented by Los Angeles attorney Kenneth Widelitz.

Widelitz also suggested a plan for getting the association " off the ground." An interest-bearing trust account will be established. Store owners interested in forming a national association should send a $100 check made out to the account, and include comments and ideas along with their remittance. Checks should be made payable to Computer Retailer's Association and sent to Kenneth Widelitz, 10960 Wilshire Boulevard #1504, Los Angeles CA 90024.

If less than 20 computer-store owners respond – the minimum number required to form a trade association in California, according to Widelitz – each $100 contribution, plus interest, will be refunded.

Contributors to the trust account will be charter members of the association.

No later than November 15, Widelitz will report on the status of the trust account listing the contributors and including a ballot for selecting a committee of owners to finalize the articles of incorporation and the bylaws.

These committee members will likely serve as the initial directors of the association.

THE HEATHKIT FORUM

Charles Floto

I didn't have long to wait for an opinion exactly opposite of that expressed by John M. Blalock in last month's Forum. Rik Nilsson of Antioch CA laments:

"I don't care how noisy the S-100 bus is; I was disappointed almost to tears when, after a two-year wait, Heathkit produced an otherwise very attractive micro, but with a unique bus system!

"I realize this was a smooth marketing approach, since customers will have to buy Heath memory and I/O cards plus their rather limited CRT terminal to get a system up and running.

"If Heathkit really had the consumer in mind why couldn't they have made the H8 capable of accepting the nearly two hundred S-100 compatible circuit cards now available?

"The H8's really attractive feature is the slick front panel. I also am glad they were able to produce a paper-tape peripheral of such sophistication for an affordable price. Maybe we'll see some competition in this area from others.

"Once an admirer of Heath's engineering expertise, I am now going reluctantly elsewhere for my system. Sorry guys!"

I think Rik is premature in assuming the Heath Company will have a monopoly on selling to H8 owners. A quick check reveals at least five other companies that supply circuit cards to fit the SWTPC 6800; we can expect a similar situation to develop with the H8.

A Request for Aid

Our first request for assistance comes from the state of Washington. Wouldn't be surprised if he reads *73*, too, as he signed the letter with his radio call, K7DPO. Tom McKenna starts by disagreeing with Rik:

"The H8 computer is for me, as a longtime Heathkit user. This will be my introduction to the hobby, and I am counting on the Heathkit helpfulness previously encountered. I am not much for games but want to get practical with accounting and data-handling problems as soon as possible – so the sooner the better for their floppy disk and printer.

"As a beginner it would be foolish of me to buy the whole package without some hands-on experience, although I am tempted. I plan to start with the H8 computer, H8-1 memory, H8-5 serial I/O interface, cassette recorder and sufficient software, and will utilize my Model 15RO TTY printer, Model 14TD and reperforator, I know it will be slow, but speed is not a factor until I become more proficient. Besides, I need the hard copy for the problem solving I have in mind. For me the Model 15 will have to do, at least till Heathkit comes up with the printer, but it does leave me with a quandary – what is the best way to interface with the 45 baud of the Model 15 (Heathkit H8-5 serial I/O interface's lowest baud is 110)?"

If you have a Model 15 hooked to your computer, let's hear from you.

Comments on Heath and DEC

From the West Coast view of the H8, let's go to some Virginia observations on the H11. Richard W. Schugardt writes of Heath Company:

"1. I have previously built a color TV and found their manuals to be clear, complete, and easy to understand since they make no assumptions about the background and skill level of the reader.

"2. They offer (me anyway) a local outlet for national sales and service.

"3. If they are consistent I expect to get a good (not superior) product for a moderate price. I do not feel that I am saving money by building the kit, but it might cut down on the maintenance expense."

Then he turns to Digital Equipment Corporation, maker of the LSI-11 board on which H11 is based:

"1. A strong company that is, and will continue to be, a leader in the minicomputer market.

"2. I work in a company that has a DEC 11/70, and I have noted what seems to be a good reliability factor.

"3. The LSI-11 is bigger than I need, but I hope to turn this into a commercial venture, and the thought that this software is upwardly compatible makes it worth high initial cost.

"I am anxious to find out what you think of the Heath computer line and what some of the other comments are that people sent in."

Heath Company sources indicate there'll be a stripped-down kit version of Heath's X-Y plotter; their extended BASIC includes commands for this application. Demonstrations I saw used a digital-to-analog converter built on the solderless prototyping board coming out in a few months.

To Sum Up

Next month, I hope to have some comments from *Kilobaud* readers who have built an H8. Here's a letter from Brian O'Connell of Woodland Hills CA.

"I have been following, with great interest, the development of microcomputer systems since December 1976. Since that time, there have been many new products announced, and it has been fascinating to see a new industry evolve so rapidly.

"I have had my favorite systems, starting with the Poly-88. I liked their philosophy of making the computer a welcome part of a home, and liked the powerful video terminal-based programming.

"With the advent of the Zilog Z-80, I sort of put the Intel 8080A out of the picture, because of the claims of the Z-80's superiority, and became very interested in Z-80-based systems – such as the Digital Group and the TDL Xitan system.

"Meanwhile, I read articles and letters in the computer magazines and talked to some people in computer shops around Los Angeles, and it seemed like there were some major problems for a first-time kit builder with very minimal electronics experience to successfully get 'up and running' without a lot of hassles. Even the better known companies were having quality-control and delivery problems.

"Knowing that microcomputers were a natural for Heath Company, it was only a matter of time before they would enter the market. I figured that Heath would spend a great deal of time and money to thoroughly research the market and then design their own systems from the ground up.

"When the first rumors about their selling the DEC LSI-11 came around, it became very exciting just thinking about the power and possibilities of that machine. I was disappointed to find that the H11 will only work with paper-tape I/O. Besides that, I talked to a Byte Shop employee, who warned about the complexity of interfacing that machine with home brew I/O devices.

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BOOKS

Mathematical Elements for Computer Graphics
David F. Rogers
J. Alan Adams
McGraw Hill, Inc.
1976

I have always been intrigued by the possibilities of computer graphics. We have all seen the pictures in books such as *Artist and Computer* by Ruth Leavitt, but how are these pictures made? How can we pursue such applications as computer-aided design? Assuming that hardware consisting of a plotter or CRT vector display is available, one only needs suitable software. Those of us with limited math backgrounds can produce a simple two-dimensional picture by using coordinates in an x-y plane, but we can forget about generating and manipulating three-dimensional pictures.

Here is where *Mathematical Elements for Computer Graphics* comes in. This book presents a fairly comprehensive background in the mathematical theory behind computer graphics, but don't let it scare you away. The explanations are extremely clear and simple, beginning with the representation of a point in a matrix. A discussion of techniques for representing lines, curves and surfaces in a computer follows. The book goes on to describe ways of manipulating the data representing the figures made up of various lines and curves. These manipulations include: rotation, reflection, translation, projection, scaling, perspective and stereo views.

The appendix contains BASIC subroutines for most of the graphics manipulations described, and with the help of these and the information in this book, you can develop an extremely complete and sophisticated graphics program for your computer.

Glenn S. Meader
Reston VA

TV Typewriter Cookbook
Don Lancaster
Howard W. Sams and Co., 1976
$9.95

There's only one thing worse than having to listen to the rickity-clak-clak of a paper-pounding Teletype – not being able to afford one in the first place. Perhaps you too have had the occasion to ask yourself, "How can I provide myself with the type of input/output equipment I deserve without having to take out a second mortgage on my home?"

In his *TV Typewriter Cookbook*, Don Lancaster comes to the rescue with some fascinating answers. And what's more, he does it in conversational English, which can be very refreshing to those of us who instinctively shy away from the tiringly technical.

He focuses on low-cost television display techniques, covering methods for dot-matrix character generation and computer graphics, and shows how they can be implemented using ordinary TV sets.

The first chapter outlines the basics of how the dots get where they're going and clearly defines terms that may be new to the computer hobbyist.

Chapter two digresses from the main theme to provide us with a condensed catalog of some of the more commonly used integrated circuits.

We are then introduced to the fascinating world of dot-matrix character generation. A variety of options is explored, as well as the memory required to put them into operation. There is even a printed-circuit pattern for a 1024 by 8 RAM, which can be hobbyist-duplicated on a single-sided PC board. Here is an ideal opportunity to save a bundle on the high cost of memory.

Chapters four and five cover timing, cursor, and update circuitry techniques. This is where it begins to get sticky, so you may want to read this part twice. In any case there is a complete cursor and update circuit shown at the end of the chapter, which helps to put all the pieces together.

The sixth chapter invites us to explore several keyboard possibilities. There's more than one way to get from here to there, and this section gives a brief treatment of the advantages of different keyboard styles.

The mysterious UART is dissected in chapter seven, shedding some much-needed light on everything from baud rate to bit boffer.

Chapter eight brings us back once again to the standard everybody-has-one TV set. There are two basic methods for getting information from the microcomputer to the TV – direct video and RF entry. As FCC approval is required for RF entry (video games use this technique), this method is mentioned only briefly. Instead, we are shown how to easily modify our TV sets for direct video, while still maintaining our capacity for watching "The Waltons."

The ninth and final chapter deals with hardcopy peripherals (printers). There is an interesting section on an easy and relatively cheap way of converting an office Selectric typewriter into a workable Teletype substitute. The last part toys with the idea of inexpensive color graphics. But somehow I think the software would be something else.

I have to say that the *TV Typewriter Cookbook* is one of the best books I've seen as far as the hobbyist is concerned. It is a great introduction for those who are still struggling with all the weird words. All in all, it's one of the best books I've ever borrowed.

Carl A. Wenrich
Shillington PA

The BASIC Workbook Creative Techniques For Beginning Programmers
Kenneth Schoman, Jr.
Hayden Book Co., Inc.
$4.25

The BASIC Workbook is not a textbook that will teach you all about BASIC. It is a student workbook, designed to be used with a regular series of lectures. It covers only a fundamental subset of BASIC statements, which are probably universal to most BASIC interpreters, and covers them very well indeed. Once a student has learned these statements, he will be able to write almost any BASIC program and should be able to learn any other BASIC statements on his own with no difficulty.

The BASIC Workbook consists of ten chapters and three appendices. The chapters deal with computers and problem solving, elementary statements, the art of programming, loops, functions, arrays, I/O, strings, developing larger programs and simulation. Appendix A is a "cheat sheet" showing all the BASIC statements used in the book. Appendix B tells how to correct mistakes at the terminal and briefly mentions debugging. Appendix C gives three programs to plot graphs on a standard terminal. Finally, there is a comprehensive index.

Since the workbook assumes that the student has

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LETTERS

KIM Forum

"The KIM Forum" is great. It satisfies a need caused by the fact that telling us that something is possible on microcomputers in general does not tell us how to accomplish that thing on a particular microcomputer. The more information you can supply in *Kilobaud* about what can be done, how to do it and where to learn how to do it, the better. Since I'm interested in the KIM-1, I'm really pleased that you're running articles on KIM and that you've started the KIM Forum. Please keep giving us how-to articles on the KIM-1 and other 6502 processors, and on hardware and software. And please include articles on projects simple enough even for me, but print the more complex stuff, too; I'll save it for later. The advertisements in *Kilobaud* are informative, too, but don't let *Kilobaud* degenerate into nothing but a pile of commercials. What we crave is articles with content – articles that tell us what we can do, how to do it and how to learn more.

Thanks, and keep it up.

G. David Kuhlman
San Diego CA

I really don't have much control over the fact there is a continuing supply of articles on the KIM. KIM owners like their little machines with a fervor . . . and they like to write about what they're doing with them. I think it's great. – John.

Consumer Unrest

It really burns me up to see how understanding the computer hobby publications (like *Kilobaud*) are to the problems of hobby computer manufacturers. In my opinion, there has not been comparable concern for the computer hobby consumer. There should be!! I will admit that most of the manufacturers and computer store dealers are not crooks, but the extremely long delays between product announcement and product delivery (in my opinion) encourages unscrupulous activity.

For example, I ordered a Helios II system from Processor Technology in early December 1976, and it still has yet to arrive. A friend of mine ordered a Digital Group printer in early January, and he is now being told to expect delivery sometime in September or October.

Then there's Peripheral Vision's advertisement for their $750 floppy. The Computer Store in Santa Monica ordered several of these in January, and eight months later they still haven't seen them.

Of course, I shouldn't leave out Imsai's advertisements last year for their color graphics boards. Has anyone seen or received any of these "phantom boards?" Or what about the problems people were having with the Mits dynamic memory?

Please try to be more consumer oriented and help prospective microcomputer enthusiasts (as well as the old-timers) find the best products to buy and the best people to deal with. Also, please try to inform us of the lousy products and bad dealers so that the harm they cause is minimized.

Kenneth Young
Los Angeles CA

Thank you, Ken. I received a new product announcement from a company the other day (Forethought Products in Coburg, Oregon) that wasn't really for a new product. It was actually for a product they had already been shipping . . . they just wanted to make sure that production was established before sending out new product announcements. Naturally, this isn't always going to be an easy thing for small companies, just getting started, to do . . . but this business of advertising (in any way) three or four months before the product is finalized has to stop. Interestingly enough, you didn't mention small companies in your letter . . . they're all heavyweights. I can't see how any of them can have an excuse. It's a difficult problem, and one for which we're trying to come up with some solutions. – John.

Publisher's note: Though some manufacturers get very uptight over efforts by Kilobaud *and* 73 Magazine *to help with consumer complaints, we do persist. But unless we hear about these problems, there is nothing we can do . . . and you have little complaint about magazines not doing anything if you don't let them know. Here is what you do when you have a problem with a product or a manufacturer . . . whether it be a bum product or a seemingly imaginary product: Write a letter to the manufacturer giving all details of the problem. Send the letter to the manufacturer and a copy to* Kilobaud. *The problems mentioned in your letter may have upset you, but not enough for you to let me know about them . . . and little mail has come from anyone about these problems. As long as customers shrug off these things, I doubt that manufacturers will be responsive. The ball is your court . . . not the manufacturers' . . . Wayne.*

Thanks, But No Thanks

The publisher's remarks in the September issue regarding the number of computer hobbyists leveling off touched a nerve. Would you be interested in the reaction of someone who was all set to buy a personal computer but is now at least temporarily turned off? I know of two others like me, and there must be thousands more.

Let's start with what a home computer will do. All I can find out from magazines, books and four computer stores is that its uses are "limited only by my imagination." I must have heard or read these words a dozen times. Beyond that, I am told that a home computer is good for recipes, appointments, tax returns and games. What about these?

1. Recipes. My wife cannot understand why it is easier or more fun to consult a computer (which may not be in the kitchen) than to pull a 3 x 5 card out of her carefully indexed box.

2. Appointments. Why should I punch appointments into a computer and then have to erase them as days go by, rather than continue to write them in my handy three-year calendar book, where postponements and cancellations are easier to record?

3. Tax returns. A possible plus for computers, but a very small one for 90 percent of all taxpayers.

4. Games. With Fairchild and others offering so many games for the home television set, it seems that various versions of Star Trek are the chief attraction for computers. Here again, people keep saying, "Invent your own games." My guess is that there will be a continuing flow of ever-more-sophisticated games for the home TV, leaving me with the conclusion that this, too, is a questionable computer benefit.

I understand the attraction that playing with computers has for electronic and technical experts, but, as the remarks imply, that group does not seem to offer much hope for rapidly expanding the market. I have built amplifiers from

kits, but I am not remotely interested in assembling a computer, particularly when I don't know what it will do when it is finished.

Suppose, when television was first offered for the home market, we were told to buy the chassis at one place, the picture tube at another and the tuner (keyboard) someplace else. Or, by the time these were all offered in one cabinet, we were told we would have to learn to speak with the tuner in its own incomprehensible language before we could get programs. And, finally, after we bought the set and had it working, we learned that there were lots of programs we could not receive because our set was incompatible.

In my quest, I visited four retail computer stores in California. Without exception they gave me the clear impression that unless I wanted to buy a basic computer, a stack of books, and work hard at learning at least some programming, I did not belong in computing. When I asked how I could acquire a computer already set up and programmed so that all I did was plug it in, I was given vague estimates all the way from $3000 to $15,000. The chief selling point was how much hobby-type fun it is to put together and then expand a personal computer. Is this work and experimentation the end in itself, or should the real objective be to learn to use it in some productive and enjoyable way?

Even demonstrations of complete systems were unconvincing because there was no answer to what they were capable of doing. They would do nothing until I programmed them to do something.

Your remarks about standardization are very sensible, but I think are understated. Of course the small-computer industry will grow, but only at a fraction of its true potential until a buyer can take home a complete set already programmed, and can purchase virtually unlimited additional programs without learning any language other than English – all for the price of a good television set. The only accessories I visualize would be a printer and additional disks or cartridges.

Marketing experts had better come up with specific and attractive purposes for home computers if they are to compete successfully in the mass market. The day when we pay bills and transact other business through a home computer will be a lot longer coming if computers are not first accepted as desirable home appliances.

I realize that the hobbyists and the small manufacturers are laying the groundwork for the industry's future, but I believe that unless the goals of the industry are clearly understood those ten million home computers everybody is predicting are going to be a long time coming.

Carl K. Revelle
Sun Lakes AZ

The End of "The Computerist"

I have received many letters, requests for information and subscriptions to *The Computerist* since publication of my article, "Is the KIM-1 For Every-1?" in the August issue of *Kilobaud.* While all of this is generally good, it does present a few problems that perhaps a short note in your magazine could help alleviate.

1. I will try to answer specific questions raised in letters, but do not have the time to go into long philosophical, speculative discussions.

2. If individuals wishing information about the KIM-related product line offered by *The Computerist* would enclose a business-size SASE, we will be happy to send them our summer catalog and a free 6502/KIM Programmer's Reference Card.

3. Even though our publication, *The Computerist*, had become a commercial success and had given me great personal satisfaction, we stopped publication with the August issue. This was because we were not getting enough meaningful input from individuals, clubs, stores or businesses in the New England region to produce what we considered a meaningful publication. So, please ask your readers *not* to send in any more subscriptions. It really hurts to have to return the money!

Robert M. Tripp
PO Box 3
S. Chelmsford MA 01824

Comments on "Heavy Duty Altair Power Supply" Issue No 8 . . .

It's rare that I put down a new issue of *Kilobaud*

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EDITOR'S REMARKS

from page 7

the special demonstration booth set up by Marcia Swampfelder. Marcia is a world-renowned author for *Popular Electronics* magazine. If you didn't catch her classic "Hobby Scene" in the April '77 issue, I strongly suggest you steal a copy (if necessary) and read it. I hope we'll be able to get Marcia to come back for the next "big event," and she'll very likely be joined by some other top names in the field. We'll also have demo systems set up for home and small-business applications, and invite non-hobbyists to come out for a look-see.

THE HEATHKIT FORUM

from page 18

"Because of my preoccupation with the Z-80 I hadn't thought much about buying the 8080-based H8, but after I read the specs a few times, my ideas soon changed. The 8080 contains a very nice instruction set, and for purposes of learning and most household uses I have come to the conclusion that the extra goodies on the Z-80 may not be that big a deal.

"One of the best features of the H8 system is the front panel. Having immediate access to memory and dynamic display of memory contents during execution makes learning and debugging much easier. The Benton Harbor Extended BASIC, featuring front-panel I/O, will be very useful in certain applications, such as games for two players.

"The fact that Heathkit doesn't use the S-100 bus doesn't bother me since I have no immediate needs for any 'toys' like the Dazzler and music boards. Electrically, that bus isn't the most efficient and, anyway, it won't be long before new products will be created for the Benton Harbor bus.

"I think that the Heathkit H8 will prove to be a very popular system and attract a lot of people, such as myself, who have been a little apprehensive about plunging into the microcomputer jungle."

Brian certainly sums up a lot of concerns and expectations. So that future forums can reflect whether these hopes are justified, I'd like to hear from you. Write:

The Heathkit® Forum
c/o Charles Floto
267 Willow Street
New Haven CT 06511

Heathkit is a registered trademark of the Heath Company, Benton Harbor MI.

BOOKS

from page 19

attended a lecture, it does not go into great detail about any of the BASIC statements. The text of each chapter contains a summary of the BASIC statements covered, a sample statement and a sample program using the statement. There are over 40 sample programs in the workbook, ranging from a three-line program to assign a value to a variable and then print the variable, to a program that simulates the waiting time of customers at an auto-repair shop.

Except for chapter one, the text of each chapter is followed by a set of suggested problems. Each problem is a program that the student is to write. Most have notes giving any mathematical formulas needed, suggested test data or other comments about the types of input you should allow for, or methods to use for the solution. Each problem is on a separate page, with a large blank area in which the student may take notes. There are over 60 of these problems in the workbook. They are well chosen, both to test the student's skill with the various BASIC statements and for their usefulness. Problems include sorting, searching and merging routines, math routines, games and a stock-market simulation!

I have only one complaint with the workbook: Of ten chapters, only one is devoted to strings, and this contains only two pages of text and doesn't mention many of the common string functions. For example, there is no mention of Mits BASIC RIGHT$, LEFT$ or MID$ functions. The ability to handle strings is one of the features that makes a computer more than an overgrown calculator, and I think it deserves more space than it was given. In defense of the workbook, I must say that this minimal treatment of strings is common to most of the teaching materials on BASIC.

In all, I think *The BASIC Workbook* has filled a gap in the teaching of BASIC. A student already familiar with programming in other languages can probably learn BASIC quite speedily from the workbook, without the need for lectures. With the workbook, such a student will not have to waste time sifting through lengthy discussions on how to program in order to learn the statements of the BASIC language, but can read the summaries and be writing BASIC programs in a short time. The rank beginner, on the other hand, will need some sort of lecture or additional instruction. For him, the workbook will be a very good set of class notes, which are even indexed! This will free the student to concentrate on the lecturer in class. I certainly plan to use *The BASIC Workbook* in the next class I teach!

Glen Charnock
Oxnard CA

NEW PRODUCTS

from page 11

be used as a sophisticated desk calculator or can execute complex programs stored on the system tape.

Delivery is 30 to 45 days from TLF, P.O. Box 2298, Littleton CO 80161.

Easy-to-Install Altair Card Guides

The Computer Store, Inc., has recently introduced a new card guide, which is extremely easy to install. Instead of the usual two screws to secure the guide, these guides use only one screw and a plastic stud (which helps with alignment also). They are priced at 96 cents and are available from: The Computer Store, 120 Cambridge street, Burlington MA.

PUBLISHER'S REMARKS

from page 5

heat, etc., I think it would be very interesting to our readers.

Business Systems

More and more readers are working on microcomputer systems for business, and I'd like to see some articles on this. What configurations have you worked out . . . and where did you get the software? Is it available? Keep in mind that a $12,000 microcomputer system leases to a business for about $300 per month, about half the cost of an additional employee. A system like this could be quite a package.

I should think most businesses would want at

least a dual floppy-disk system, with one good typewriter for business correspondence and perhaps an inexpensive printer for labels, inventory, in-house records, daily sales and things like that, which wouldn't require the beautiful printing of letters, but would ask for speed and low cost.

Most readers are interested in business applications . . . and the software involved. As I've said before, we will be making programs available that have been submitted to *Kilobaud* . . . and we will pay full royalties to such programmers, even though the programs may have been published in the magazine. It's something to think about when you are trying to decide which magazine should get your new hot program.

THE BASIC FORUM

from page 13

tions. Keep up the good work."

From Joseph C. Sharp, 3396 Middlefield Road, Palo Alto CA 94306: "Educational applications need time out for replies, so further elaboration or prompting is possible.

"I suggest use of parenthesis on INPUT to specify time in seconds and interrupt label number (see Example 1)."

We offered a programming problem for our readers to solve. Being new at this business, however, we failed to realize that we would be going to press with this column before getting any feedback on the problem. The problem only appeared in issue No. 9 (September), so we are going to hold off until next time publishing a solution so that you can have a go at solving it.

Meanwhile, we offer a little programming tip for your consideration. One of the most powerful programming tools involves solving calculation problems by the use of iterative techniques, that is, by repeating the same series of operations again and again. For some reason, the novice programmer does not come equipped for iterative calculations. He soon learns how these techniques lead to simpler and often more efficient program structures. Take the problem of averaging a list of grades. An acquaintance and newcomer to BASIC brought me the program shown in Example 2, with the complaint that he was tired of handling so many different variable names.

His program lacked versatility since it would only work for 25 grades. In addition, my friend complained that if he goofed up one INPUT, he had to go back and do the whole thing over. Iteration to the rescue! We suggested that he devise a scheme whereby the same basic calculation could be done over and over again. With our help, he wrote the program in Example 3 using an iterative calculation.

Note how much more

continued on page 48

Everything about Assemblers!

. . . sure beats hand-coding

Lance A. Leventhal
P.O. Box 1258
Rancho Santa Fe CA 92067

Assembly language is a widely used method for writing programs for both large and small computers. Assemblers are inexpensive and available from many sources. The user can read an assembler into memory from paper tape or cassette, store it on a floppy disk system like the popular ICOM (Photo 1), or even save it on a PROM board like the Computer Automation PROM board shown in Photo 2. This article will discuss the basic functions of a simple assembler and describe a few of the advanced features of more complex assemblers. A later article will discuss such features as pseudo-operations, macros, and conditional assembly.

The assembler is the first major piece of systems software that most users encounter. Writing an assembler is fairly complicated (we will discuss some of the procedures involved in later articles), and most users prefer to buy or borrow one. The assembler is a systems program since it aids the user in writing actual working programs. As described in a previous article, an assembler is intermediate in complexity between an octal or hexadecimal loader and a compiler. Assembly language programming is not simple, but it is certainly easier than writing directly in machine language, and the programs are more efficient than those written in BASIC or other high-level languages. Figs. 1 and 2 show how assembly language compares to the other options in terms of ease of programming and efficient use of memory.

Translating Operation Codes

The basic function of the assembler is to translate mnemonic operation codes into their binary equivalents. The mnemonic codes are the ADD, SUB, JMP and OR, which the programmer can understand, rather than the binary numbers that the computer can execute directly. Most assemblers use the mnemonics that the CPU manufacturer provides; these mnemonics usually are far from perfect but are at least standard. The assembler translates the mnemonic codes by looking them up in a fixed table and searching until it either finds the correct code or determines that the operation code is not there (i.e., the user has misspelled the code or made some other error). The table is moderately large. For example, an Intel 8080-based computer like the Imsai 8080 (Photo 3) has 78 operation codes while a Zilog Z-80-based computer like the Cromemco Z-2 (Photo 4) has 158. The assembler will need some RAM to hold the input code and use for temporary storage. It may also do some preprocessing to avoid having to search the entire table (e.g., it might determine which half of the table would contain the operation code).

Occasionally, the mnemonic code table is not fixed. In that case, the user can make the assembler handle any set of operation codes or instruction formats. Such generalized assemblers are called *meta-assemblers.* They can easily be configured

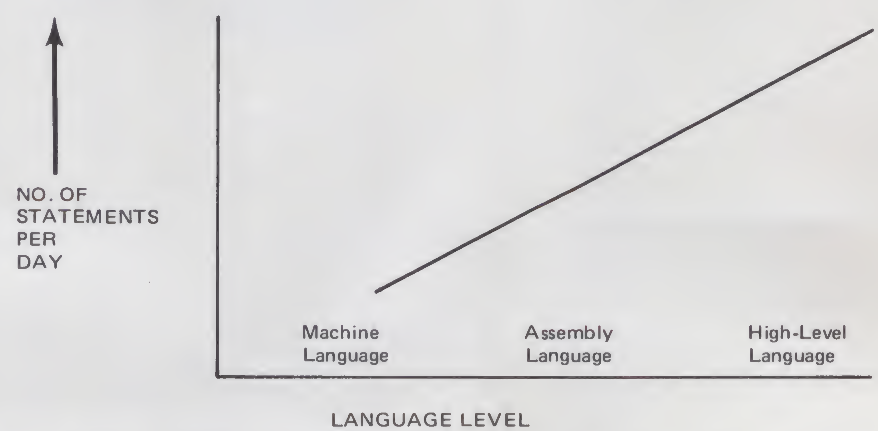

Fig. 1. Ease of programming vs language level. Experts generally agree that a programmer working in a high-level language (such as BASIC) can produce ten times as many machine instructions per day as can a programmer working in assembly language. The ratio for machine language is still larger.

Photo 1. The ICOM Frugal Floppy, a popular floppy disk system for use with small computers. Courtesy of ICOM Microperipherals, Canoga Park CA.

Photo 2. The Computer Automation NAKED MILLI EPROM Board; it can hold either applications or systems software in permanent storage. Courtesy of Computer Automation, Inc., Irvine CA.

to handle assembly for a new computer or CPU, or for a custom instruction set devised by microprogramming. The meta-assembler is very flexible but may not offer as many features as a specialized assembler. Furthermore, the user has to define the instruction set properly for each CPU.

Note that there is no particular standardization among assemblers. The mere fact that computers use the same CPU as the Mits Altair 680b and the Southwest Technical Products SWTPC 6800 (Photos 5 and 6) does not mean that those computers must or can use the same assemblers. Most manufacturers write their own assemblers for their own particular configurations. There is no reason why they even have to use the mnemonic codes suggested by the CPU manufacturers (although most do). Assemblers can and do vary greatly, and the beginner should not assume that any two work in exactly the same way. There are no standards as there are for high-level languages such as FORTRAN or PL/I. Of course, most assemblers only work for one CPU, so they do not have the generality of high-level languages.

Finding the Address

Even a simple assembler must do a little more than just translate operation codes into machine language instructions. It will also have to determine what data or addresses each instruction requires. Here, the assembler will divide the instruction set into groups and use a different subroutine for each group. Some instructions, like HALT, CLEAR ACCUMULATOR, or ENABLE INTERRUPTS, do not need any data or addresses. Others, like JUMP, CLEAR (a memory location), or ADD usually require one address or data item. Instructions like LOAD, MOVE, or COMPARE may require two addresses. Consider, for example, the variations in the Intel 8080 instruction set: RAR, RAL, EI, XCHG, and CMA, among others, require no data or addresses; ADD, SUB, ORA, INR, and DCR, among others require a register address; ADI and ANI require eight bits of data; JMP, STA, and LDA require a 16-bit memory address; LXI requires 16 bits of data; and MOV requires two register addresses.

Here, again, the assembler also searches for errors such as wrong number or type of operands, incorrect formats (such as a character that is not a digit in a decimal number), and addresses too large for the system. The assembler usually marks each error with a code (letter or number) in the listing. It also completes the line as best it can and proceeds to the rest of the program. The user thus gets the maximum benefit from the assembly.

Note that the main task of the assembler is text analysis. It does very little arithmetic (not much more than counting) and does not do complex input/output. Most of the assembler's time is spent looking for the right symbol in the right place. For example, the assembler must know that a digit accidentally typed into an operation code is an error, and that anything except a digit typed into a number is also an error. The

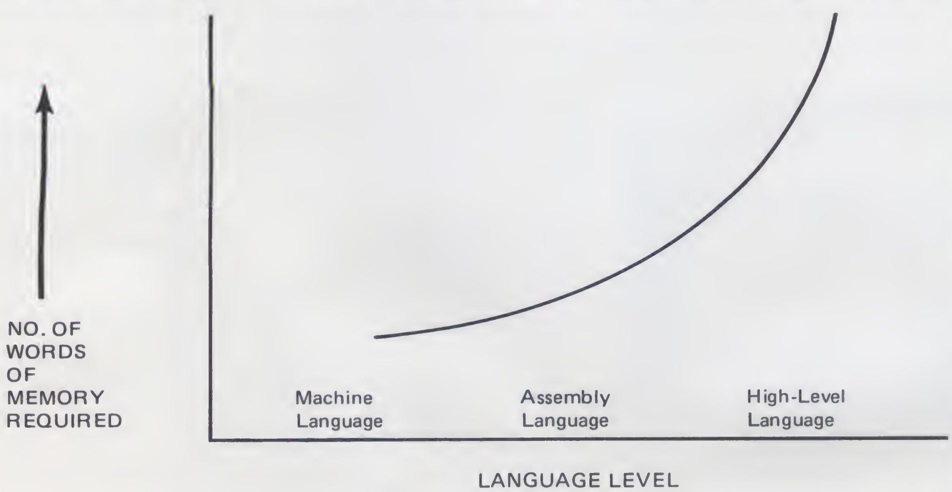

Fig. 2. Memory usage vs language level. Programs written in high-level languages typically require 50 to 300 percent more memory than those written in assembly or machine language. Furthermore, many tasks involving precise control and complex I/O manipulations may be almost impossible to perform in a high-level language.

assembler must determine where names and numbers begin and end, whether a name has been defined or not, and what the actual binary meaning of the name or number is. Many of these operations are typical of the tasks involved in systems software. You do not need to be a mathematician or an electrical engineer to write such programs; you do have to be able to plan well and think logically.

Photo 3. The IMSAI 8080, a computer based on the Intel 8080 microprocessor. It has 78 separate operation codes. Courtesy of IMS Associates, San Leandro CA.

Photo 4. The Cromemco Z-2, a computer based on the Zilog Z-80 microprocessor. It has 158 separate operation codes. Courtesy of Cromemco Inc., Mountain View CA.

Photo 5. The Mits Altair 680b, a computer based on the Motorola 6800 microprocessor. Its systems software will be different from that available with other 6800-based computers. Courtesy of Mits, Inc., Albuquerque, NM.

The combination of operation code and address or data forms an *assembly language statement*. The assembler will translate each statement into a single computer instruction (which may, however, occupy several bytes of memory). This one-to-one correspondence between statements and instructions is characteristic of assemblers; assembly language is therefore a *low-level language*. The programmer has complete control over exactly how the program uses the registers, flags, and other resources of the computer. However, the programmer also is responsible for handling all the resources properly.

Getting the Output

Of course, the user must start the whole process by loading the assembler into memory if it is not in PROM. Since the assemblers are typically several thousand words long, a cassette system like the one shown with the Microkit 8/16 in Photo 7 is convenient. Even better is a floppy disk like the Micropolis MetaFloppy shown in Photo 8.

Note that the assembler generally provides output on paper tape, cassette, or a disk file. We call the result *object code* and the input a *source program*. The user will still need a loader program to enter the object code into the computer memory. Assemblers that run under a floppy disk or cassette operating system may place the object code on the disk or in memory. The system will have commands that run the program immediately or save it in a file.

The form of the object code varies. So each assembler needs a special, compatible loader. The instructions are the same if the CPU is the same, but the format, code, record length, and special symbols will vary. Besides the actual instructions, the assembler must also include in the object code information as to where sections of the code begin, the length and type of records, and error checks, so the user can be sure that the program has been read correctly. Some assemblers provide even more information, which allows the loader to place the program anywhere in memory or fill in references to library routines.

Adding More Features

Older assemblers and some small assemblers do little more than translate operation codes and handle addresses. Users can at least write programs with the mnemonics rather than with binary, hexadecimal, or octal instruction codes. However, data and addresses still must be in binary, hexadecimal, or octal. The user must set aside all the memory locations, keep track of addresses, and enter fixed data such as messages or tables directly into memory.

Newer and larger assemblers, however, can do much more than these simple tasks. In fact, some assemblers have so many features that they are really more like compilers. We should note that the more features the assembler has, the larger it will be. It will occupy more memory and may run slower and require more peripherals. The user must decide if the extra features are worth the extra cost. Computers like the PDP 11/45 in Photo 9 have extensive assemblers with many convenient features; however, such assemblers can easily occupy 16K of memory instead of the 4K required by simpler assemblers.

Dividing Statements into Fields

The larger assemblers are field-organized; each statement is divided into several sections or *fields*. The user will have to separate the fields in some way so the assembler can tell where one field ends and the next begins. Typically, a space is

sufficient separation, although some assemblers require commas, periods, slash marks, colons, or semicolons. The idea is to use characters that are always available but are not commonly part of instruction codes, addresses, or data. The use of explicit separators means that the user does not have to worry about where the characters are placed on the line but does have to remember the proper separator or *delimiter*.

Usually an assembly language statement consists of four fields in the following order: 1. Label field. 2. Operation code field. 3. Address field. 4. Comment field. The operation field, of course, contains the mnemonic operation code; it is an essential part of each statement and cannot be omitted.

The label field assigns a name to the location in memory of a particular instruction. So, you refer to that address by name rather than by its numerical value. The assembler, of course, must translate the name back into a numerical value. As usual, this feature is convenient for the programmer but not necessary for or useful to the computer. If the instruction occupies more than one word, the assembler defines the label as the address of the first word involved.

The label field is optional. Most statements do not have labels; in fact, you generally don't put anything in the label field unless you have a specific reason for doing so. A typical reason is that the statement is the address of a jump instruction or some other operation. In that case, we generally prefer to use a label rather than a numerical address for the following reasons:

1. We can place the program anywhere in memory without changing each address. The assembler will replace each reference with the new value. This is particularly convenient if you add more memory to your system or buy a new computer with a different arrangement.

2. We can move the label (in case of an error or change in the program) without changing any of the references.

3. We can insert statements or make other corrections without problems since the label distinguishes references to the specific address from data that might happen to have the same value.

4. The label is easier to remember, particularly if it jogs the memory (i.e., it is a mnemonic).

There are, of course, some problems involved in using labels. Most assemblers place restrictions on the length, characters allowed, and first character permitted (it usually must be a letter). The user must be careful to abide by these rules, spell the label correctly, not use any undefined labels, and not use any labels twice. One practice that users must watch out for is deleting a statement that has a label; the statement may not be necessary but the label will have to go somewhere.

The address field contains the data or addresses that the instruction requires. Advanced assemblers will provide the programmer with many optional forms for describing the contents of this field. These options may include:

- Various number systems — i.e., binary, decimal, hexadecimal, or octal.
- Character codes such as ASCII or EBCDIC.
- Offsets from the present value of the program counter ($ or *).
- Symbolic names and labels.
- Arithmetic and logical combinations of other options.

The programmer may have to determine exactly what the assembler does with some of these options. The results may be far from obvious.

In many cases, these options not only save the programmer work, they also make the program easier to read. A comparison that checks to see if a character is an E is surely simpler to understand than one that looks for 45 hexadecimal, 69 decimal, or 01000101 binary. Similarly, arithmetic combinations such as START + 1 or PAGE* 256 can make the programmer's intent much clearer.

Remember that the assembler must perform all the required conversions. It must recognize any special conventions such as number systems,

Photo 6. The Southwest Technical Products SWTPC 6800 Computer System, another computer based on the Motorola 6800 microprocessor. It will need a different assembler and loader than will the Mits Altair 680b. Courtesy of Southwest Technical Products, Inc., San Antonio TX.

Photo 7. The Microkit-8/16 Microcomputer Development System. Its assembler can be quickly loaded from an audio cassette. Courtesy of Microkit, Inc. Los Angeles CA.

Photo 8. The Micropolis MetaFloppy family of floppy disk systems. Systems software and user programs can reside in disk files. Courtesy of Micropolis Corporation, Northridge CA.

Photo 9. The Digital Equipment PDP 11/45, a large minicomputer with a very complex and powerful assembler. Courtesy of Digital Equipment Corporation, Maynard MA.

character codes, arithmetic operators, etc. It must actually evaluate arithmetic and logical expressions that may involve operations like multiplication and division, which the computer cannot perform with a single instruction. Each added feature is a convenience but means that the assembler will be larger and slower. The user will have to decide if extra features are really worth the price.

The comment field is strictly for the user; it can be left blank if desired. The assembler does nothing with this field except print it out in the listing. It is just explanatory material and doesn't result in any actual machine language instructions. The comments, however, can be a tremendous aid in program documentation. Proper commenting will help the user in debugging, testing, and extending the program. It will also make the program easier to use later (when the programmer may have forgotten many of the details) and simpler to explain to others. Good documentation can make many programming tasks simpler and can allow users to share their programs. Poor documentation can make programs useless, even for the originator.

What does the final product look like? Fig. 3 shows examples of assembly language programs for Intel 8080 and Motorola 6800-based computers. These programs create a moving "newspanel" display, in which the characters appear to move across the lights. Note the use of all the fields and the special delimiters (colon, semicolon, number sign, and comma) required to separate fields or entries and mark special usages.* These assembly language programs create a moving display by incrementing the starting address of the output data after each iteration. All the fields are used. Note that many statements do not have labels and some do not require addresses. ■

*For more details about the programs, see L. A. Leventhal, "Take Advantage of 8080 and 6800 Data Manipulation Capabilities," *Electronic Design*, April 12, 1977, pp. 90-97.

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```
          INTEL 8080
DSTRT:    LXI     H, MESSG    ;  PTR, DPTR = START OF MESSAGE
          MVI     A, NMESS    ;  CTR = LENGTH OF MESSAGE
DRUN:     SHLD    PTR         ;  SAVE STARTING POINTER
          STA     CTR         ;  SAVE RUN COUNTER
          MVI     B, NDSPLY   ;  DCTR = NUMBER OF DISPLAYS
DSPLY:    MOV     A, M        ;  GET A CHARACTER FROM ARRAY
          CALL    SEND        ;  SEND CHARACTER TO DISPLAYS
          INX     H           ;  DPTR = DPTR + 1
          DCR     B           ;  DCTR = DCTR - 1
          JNZ     DSPLY       ;  SEND NDSPLY CHARACTERS
          LHLD    PTR
          INX     H           ;  UPDATE PTR TO START AT NEXT CHARACTER
          LDA     CTR
          DCR     A           ;  COUNTDOWN NUMBER OF DISPLAY RUNS
          JNZ     DRUN
          HLT

          MOTOROLA 6800
DSTRT     LDAA    #NMESS         CTR = LENGTH OF MESSAGE
          STAA    CTR            SAVE RUN COUNTER
          LDX     #MESSG         PTR, DPTR = START OF MESSAGE
DRUN      STX     PTR            SAVE STARTING POINTER
          LDAB    #NDSPLY        DCTR = NUMBER OF DISPLAYS
DSPLY     LDAA    X              GET A CHARACTER FROM ARRAY
          JSR     SEND           SEND CHARACTER TO DISPLAYS
          INX                    DPTR = DPTR +1
          DECB                   DCTR = DCTR - 1
          BNE     DSPLY          SEND NDSPLY CHARACTERS
          LDX     PTR
          INX                    UPDATE PTR TO START AT NEXT CHARACTER
          DEC     CTR            COUNTDOWN NUMBER OF DISPLAY RUNS
          BNE     DRUN
          WAI
```

Fig. 3. Examples of assembly language programs. Starting or repeating the moving display simply requires a jump to DSTRT. Subroutine SEND formats the data for the displays and provides the proper timing.

Why buy a micro, when you can buy a mini for less!

MOST OF TODAY'S PERSONAL COMPUTERS are microcomputers. Compared to our minicomputer they are slow and expensive.

Our mini "the MINI 12™" has been around for three years. We've been steadily selling it to industrial customers who have proven its reliability. Only recently have we paid much attention to the personal computing market. We've discovered that our computer is simply better, and most interestingly, LESS EXPENSIVE.

NONE OF THE MICROCOMPUTERS can offer you the range of software available to the MINI 12. Compatibility with the most popular minicomputer, DEC's PDP-8E, gives you a vast library of programs. You will also be pleasantly surprised when you experience the speed and sophistication of our EXTENDED BASIC compiler, or FORTRAN, ALGOL and FOCAL.

Unlike today's microcomputers, our Mini 12 is fully software supported by an advanced operating system, including...file handling text editor, symbolic assembler, loaders, ODT (octal debugging technique), batch processor, and system utilities.

The MINI 12 comes with 8K of memory and is easily expandable to 32K. Because the MINI 12 processes 12 bit words (instead of 8 bit bytes) you need far less memory. For most applications... using our optional MINI STORE digital cassette system with the BASIC compiler, you will never need add another single byte!

Because we want you to have the pleasure of using your minicomputer right away, our MINI 12 comes fully assembled, debugged and ready to plug in. It includes a full front panel, controller for eight digital tape drives, and built-in serial interface plus other technical niceties like a binary loader and monitor bootstrap in ROM memory.

Frankly, when compared with microcomputers, we're surprised at how good a deal we are. Write... or better yet, give us a call @303-794-1634 and let us help you get it all together!

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Sheila Clarke
Cybergrafix
P.O. Box 430
Glendale CA 91206

Your Image Counts!

... polish it before turning pro

You may be among the hobbyists-turned-professionals who got tired of programming gratis for friends, or who developed a product the hobbyist could really use. So you've decided to ease out of that secure, full-time job and start a business of your own.

There's a lot to consider now, what with business permits and licenses, location, overhead ... so much to think about that one area very often becomes obscured. Your image, or how you appear on paper to total strangers, can well make the difference between your initial success, or failure, in communicating what you have to offer. Because graphic arts for the microcomputer industry is my stock-in-trade, I would like to share with you some personal feelings and some advertising facts you should consider before going much further.

Introducing a Product

A recent experience I had with a new client illustrates how one can get caught in current involvements to the extent that one fails to plan ahead. My client had a new product that he was very excited about, and for which he wanted a full-page ad. So, I asked him what the name of his product was. "Wow, we haven't thought about that yet," he responded.

Another new manufacturer had hurriedly typed an information sheet, complete with strikeovers and corrections, and sent photostatted copies to magazine editors. Few of the editors who received the copy were willing to wade through the typographical errors and edit the copy for print. His product received little notice.

A third party sent many letters to potential customers in his community announcing his new data processing service. His letter, typed on plain white paper and Xeroxed, did not even reflect a company name. He received no responses.

Why did these, and perhaps your attempts to receive notice, fail? Maybe there's no market for what you're trying to sell. Maybe your product or service is overpriced. And maybe you just don't look like you're serious. When taking a look at these, and other possible reasons for failure, you may decide to begin again with your image. You'll soon discover that when beginning a new endeavor, it's just as important to have an advertising professional in your service as it is to have an attorney, a tax accountant and maybe United Parcel Service. What your advertising consultant should be able to help you achieve when starting a new business is included in the following checklist.

Company name: Many don't think a company name is important and have elected to do business under personal names. "John Doe, Microcomputer Consultant," and your home phone number on a business card may be sufficient to convey how your clients can reach you, but it isn't sufficient when writing away for product literature or applying for open credit with a supplier. Individuals are often overlooked in favor of established-looking firms. A company name gives the image of having been established.

Logo: Your company name should have a distinctive look. It may involve an abstract graphic design, but that isn't necessary. It may simply be your name in logotype, or attractive lettering that identifies your firm. Take a look at some established firm names. IBM, Sears, McDonald's and The Byte Shops all have logos. Anyone can. Everyone should.

Business stationery: Put that logo on everything. Your correspondence, press releases and promotional material all represent your image. The fellow who received no response for his data processing announcements did not present an established-firm look. So, I suspect, his letter was not taken seriously. A well-worded letter printed on formal business stationery should receive a five to ten percent response. That response may be achieved by following up with phone calls. If you appear to be solidly in business however, you will be treated with respect and credibility.

Free publicity: Before you anticipate an advertising budget that you don't think you can yet afford, consider the possibilities of free publicity. When you have developed a product, the first

thing you must do is obtain a good, professional photograph of it. Then have someone prepare an announcement to the press. Your press release should appear to have been written by an unbiased party who only points out the facts of your product. Those facts must include what the product is, who would be most interested in it and why, cost and availability. If you offer a warranty, say so. If you only distribute through dealers, say so. When you read a few of the product releases that appear in this issue, you'll note that none of them read like ads, but more like articles.

Include an 8 x 10 glossy photograph with your press release, which is well written and cleanly printed for distribution. Mail a set to every publication in your field. Expect 60 to 90 days to pass before you see it in print.

Another effective method of receiving free publicity is to have someone write an article that is featured in one of the well-read magazines. Whoever writes your article should be a user of your product and should know how to write. Your author must be prepared to accept correspondence and answer

Another effective method of receiving free publicity is to have someone write an article that is featured in one of the well-read magazines.

inquiries, so this effort must not be contrived.

Product reviews: Don't fall prey to department editors who promise a product review if you will provide them with one or two freebies. Whether or not they'll keep their promises is doubtful, and it just isn't necessary to bribe magazine editors. Most honestly look for good material and products to write about. If an editor offers to write about your product with the help of a borrowed unit, do take him seriously. In this case, graft is probably playing a lesser part than a sincere desire to help you expose your product.

Literature: Now that you have reason to believe you'll receive publicity in 60 to 90 days, you have sufficient time to produce the necessary literature you'll need with which to respond when inquiries start pouring in. There are a number of ways to go from here. A single or double-sided 8½ x 11 sheet with full product information might be sufficient. Later, we'll discuss whether it should be in color or black and white. The quality of your brochure or information sheet may vary widely, from smudgy Xerox copies to a slick glossy sheet. The use of lots of photos may call for a glossy stock because of superior printing capability. Somewhere between lousy and terrific will involve moderate expenditure and handle photos well enough, so look for a 60-pound or 70-pound offset stock to do an adequate job.

Regardless of how many pages and the quality of stock you decide to print, the information should be straightforward, detailed and fully outline product specifications. Include prices and delivery. Information on possible applications can be helpful to potential buyers. Everyone finds pictures easier to read than heavy text, so use as many pictures as it takes to get your message across. And make your product easy to buy. Include an order blank as part of your literature.

You've decided that production is yielding sufficient product . . . you are now ready to advertise in one or more of the major magazines.

Advertising

You've decided that production is yielding sufficient product for you to be able to ship in quantity off the shelf, and are now ready to advertise in one or more of the major magazines. Whether you decide to go one time only in a single magazine, or several times, or hit all the major magazines at once is up to you. Your decision will be based, first, on your budget and, second, on your ability to supply a heavy demand. It is suggested that one time in a magazine just won't do much of anything for you. Readers must become familiar with seeing your display, and it takes more than once or twice for your message to take effect.

If your budget is limited, pick a magazine whose readership, in your estimation, is closest to your market and contract for at least three months of advertising. The more months you contract to advertise, the lower your monthly rate will be, and the more you'll realize for your advertising dollar. Your return will be greater, too, if you advertise consistently. At first readers will not recognize you and may be suspicious. The second appearance of your ad lends greater credibility, and the third appearance gives you the status of being a member of the community.

Beginning an advertising campaign that will have effective results requires the help of an expert. The expert you select will come to you as one of two possible character types. The first type knows exactly how he or she likes to work, and will tell you without requesting much feedback. You may be better off with this type of graphics designer if you don't know your byte from an x-acto knife.

Others prefer to work with a method similar to mine and my associates'. We want as much feedback from new clients as possible because it's important to give the client as close to what he wants as he can communicate. Some of the questions I ask a new client include:

1. Tell me all about you, your company and your product.
2. What do you wish to achieve with your advertising?
3. Thumbing through the pages of this magazine, which ads strike you as being the most outstanding? Why?

The answers to two of these questions provide a great deal of necessary information. Question number two may appear ridiculous until you give thought to what your market target and sales goals are. The answer can reveal a wide variety of responses from client to client. After answering all three suf-

ficiently, enough can be gleaned to produce the type of layout that will be most effective for your product or service and will give you the feeling of having received the most for your money.

Watch Those Pitfalls

Advertisers want to get the most for their money. That's reasonable. BUT! Buying space for a quarter-page ad and then trying to fill that small space with all the bits of information you feel are essential does not mean you're getting the most for your money.

Consider, after all, that what you're trying to achieve is attention to your product. The purpose of your ad may not necessarily be to sell your product or service but, if good, to attract attention and bring you inquiries. What you do with those inquiries is what will sell your product. So, filling that space with a good-looking photograph that says more about your product than words ever could . . . that's an eye-appealing ad. Sufficient information in headline and subheads can qualify both your product and your customer. Copy information should include what the product is, what it will do (briefly, please!) and what it costs.

What About Color?

Even if your product is a black and white item, you should still add color to your ads (if budget permits). A black and white ad with the addition of one color will increase your readership; a full-color ad will produce ten times the response of a black and white ad.

At this point, when talking about an ad, we are also talking about any printed material that sells your product, including brochures. Color tells your readers that you are a company of substance, willing to compete for attention with the best of them. Other factors that come into play at a psychological level raise the readership when you use color in your advertising.

Simplicity

It's been said before, but to repeat . . . do resist the temptation to cram everything into a small amount of space. This tires the eye, and unless your reader has been looking for that very product or service, your chances of holding his attention long enough to wade through heavy text are minimal.

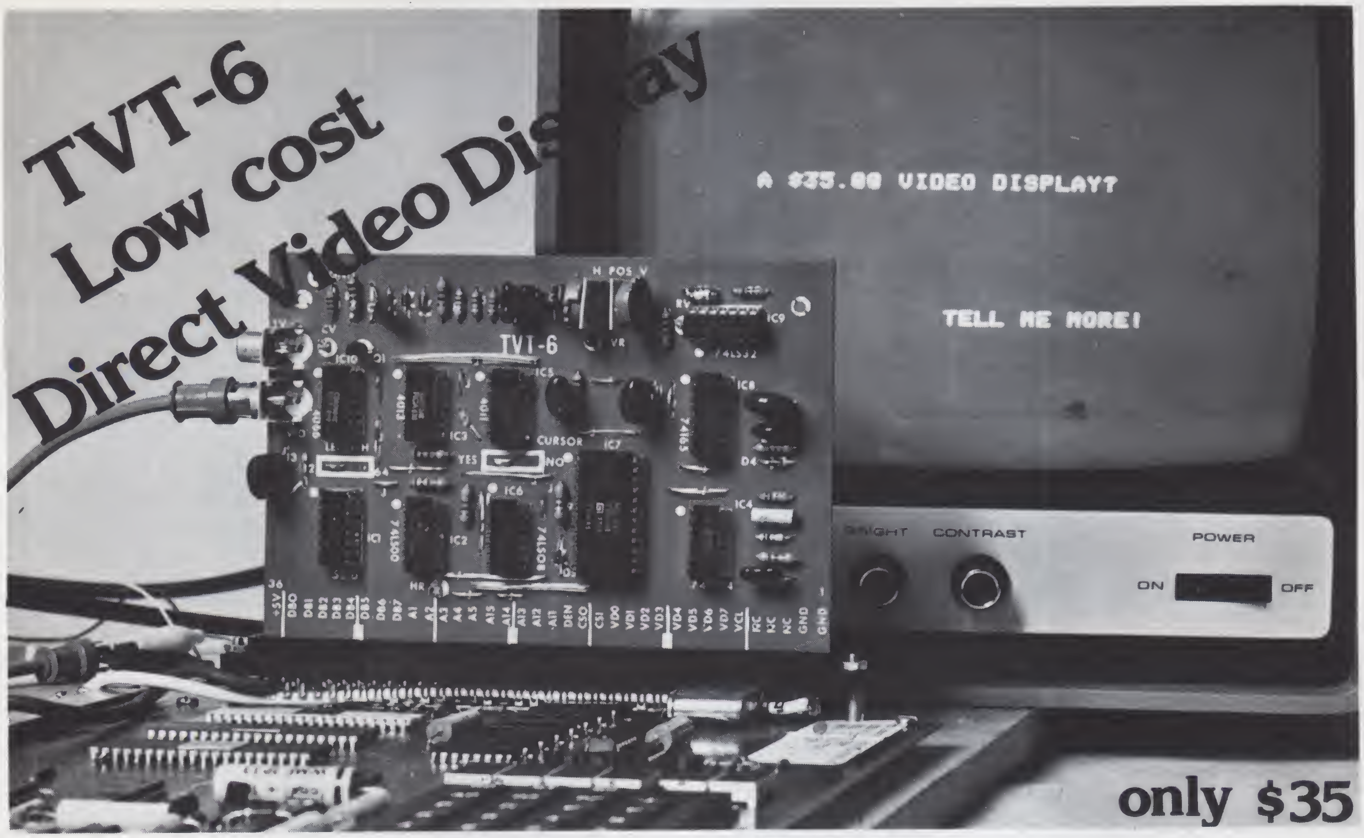
Clever copy usually doesn't come across as well as straightforward statements. Sex does not necessarily sell computers.

All Circuit Boards Look Alike

Personally, I would like to see circuit board manufacturers move away from the photo of the board alone. No matter how well it's done, to most readers one board looks like another. Though the photography costs more, seeing a board at work in a system would be a more effective approach. Seeing a *person* operating that system will give your reader someone, rather than something, to identify with, and should get better reader response. Though these extra elements tend to increase your initial advertising costs, your readers should become buyers, thus producing sales that will eventually give you a fine return on your investment.

Individuality

All remarks made in this article are generalized. Certainly exceptions may be made to every "rule" posed here. The final design of your logo, business stationery, advertising and brochures will be individual and distinct. So the above is offered as a guideline for newcomers to the game. I do hope they help you toward the right direction for achieving an effective image for your new company, product or service. ■


TVT-6
Low cost
Direct Video Dis ay
A $35.00 VIDEO DISPLAY?
TELL ME MORE!
TVT-6
CURSOR
CONTRAST
POWER
ON
OFF
only $35

Terrence Lukas
University of Illinois Medical Center
Center for Educational Development
833 S. Wood St.
Chicago IL 60612

Lifetime Program

. . . will you make it?

Presently no one can predict with any accuracy exactly how long you will live. Longevity is the result of a complex interrelationship of many known and unknown factors, some fixed and some variable. However, research has shown statistically that there are a number of detectable factors related to how long you will live. These include the general areas of heredity, health, diet, exercise, education, occupation and life-style.

Starting with individuals at least 20 years old, this program first determines your base life expectancy from your sex and present age. You are then presented with questions from the previously mentioned general areas. The questions may vary depending on your sex, present age and responses to previous questions.

After each significant question, a value is added to or subtracted from your previous subtotal, and at certain points an opportunity is given for a further explanation of key items. Although this program gives you a numerical answer, more attention should be paid to the various areas that you can control to improve your longevity.

This program was written in Mits 8K 3.1 BASIC but can be easily changed to run in any version of BASIC.

A Tarbell cassette interface tape of this program is available by contacting: Mr. Lloyd Smith, CACHE Software Library, 530 Pierce St., Dyer IN 46311. ■

Program listing (continued on following pages).

```
10 PRINT"            <<LIFETIME>>"
15 PRINT:REM WRITTEN BY TERRENCE LUKAS 4/2/77
20 PRINT" THIS PROGRAM DETERMINES YOUR LIFE EXPECTANCY"
30 PRINT:PRINT"DO YOU WANT BACKGROUND INFORMATION";
40 INPUT A$
50 IF LEFT$(A$,1)="N" THEN 130
55 PRINT
60 PRINT"THE FOLLOWING, THOUGH NOT VALIDATED, IS BASED ON THE"
70 PRINT"BEST SCIENTIFIC EVIDENCE AVAILABLE TODAY. WHILE"
80 PRINT"SCIENTISTS STILL DON'T KNOW ALL OF THE VARIABLES"
90 PRINT"CAUSING LONG LIFE, THEY ARE AWARE OF SOME OF THE"
100 PRINT"PHENOMENA THAT SEEM TO BE CORRELATED WITH LONG-"
```

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Samuel Granick, and Robert D. Patterson, *Human Aging II*, U.S. Department of Health, Education and Welfare, 1971.

Clement G. Martin, *How to Live to Be 100*, Frederick Fell, Inc., New York, 1963.

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110 PRINT"EVITY. THIS PROGRAM IS BASED ON THAT DATA AND"
120 PRINT"STARTS WITH INDIVIDUALS AT LEAST 20 YEARS OLD."
130 DIM BA(101)
140 PRINT:PRINT"WHAT IS YOUR AGE IN YEARS";
150 INPUT AY
160 IF AY <20 THEN PRINT"SORRY, YOU MUST BE AT LEAST 20 YEARS OLD.":END
170 PRINT:PRINT"WHAT IS YOUR SEX";
180 INPUT S$
190 FOR I=0 TO 101
200 READ BA(I)
210 NEXT I
220 C=AY-20
230 IF LEFT$(S$,1)="F" THEN C=C+51
240 DATA 69.9,70.0,70.1,70.2,70.3,70.4,70.5,70.6,70.7,70.8
250 DATA 70.9,70.9,71.0,71.1,71.2,71.3,71.4,71.5,71.6,71.7
260 DATA 71.8,71.9,72.0,72.2,72.3,72.5,72.6,72.8,73.0,73.2
270 DATA 73.4,73.6,73.8,74.1,74.3,74.6,74.9,75.2,75.5,75.8
280 DATA 76.2,76.5,76.9,77.3,77.7,78.1,78.6,79.0,79.5,79.9
290 DATA 80.4,77.0,77.0,77.1,77.1,77.2,77.2,77.3,77.3,77.4
300 DATA 77.4,77.5,77.5,77.5,77.6,77.6,77.7,77.8,77.8,77.9
310 DATA 78.0,78.0,78.1,78.2,78.3,78.4,78.5,78.6,78.7,78.9
320 DATA 79.0,79.1,79.3,79.4,79.6,79.7,79.9,80.1,80.3,80.5
330 DATA 80.7,80.9,81.2,81.4,81.6,81.9,82.2,82.4,82.7,83.0
340 DATA 83.3,83.6
350 PRINT:PRINT"YOUR BASE LIFE EXPECTANCY AGE IS";BA(C)
360 PRINT:T=BA(C)
370 GOSUB 3000
380 PRINT" PART I     HEREDITY"
390 GOSUB 3000
400 PRINT:PRINT"DID AT LEAST TWO OF YOUR GRANDPARENTS LIVE TO AGE"
410 PRINT"80 OR MORE";
420 INPUT A$
430 IF LEFT(A$,1)="N" THEN PRINTTAB(10)T;"+0=";T:GOTO 460
440 PRINTTAB(10)T;"+ 2 =";T+2
450 T=T+2
460 PRINT
470 PRINT"WHAT IS/WAS YOUR MOTHER'S AGE";
480 INPUT A
490 IF A <80 THEN PRINTTAB(10)T;"+ 0=";T:GOTO 510
500 PRINTTAB(10)T;"+ 1.5 =";T+1.5:T=T+1.5
510 PRINT
520 PRINT"WHAT IS/WAS YOUR FATHER'S AGE";
530 INPUT A
540 IF A <80 THEN PRINTTAB(10)T;"+ 0 =";T:GOTO 560
550 PRINTTAB(10)T;"+ 2 =";T+2:T=T+2
560 PRINT
570 PRINT"DID ANY OF YOUR GRANDPARENTS, PARENTS, BROTHERS OR"
580 PRINT"SISTERS DIE OF A HEART ATTACK OR STROKE BEFORE AGE"
590 PRINT"50";
600 INPUT A$
610 IF LEFT$(A$,1)="N"THEN PRINTTAB(10)T;"- 0 =";T:GOTO 640
620 PRINTTAB(10)T;"- 4 =";T-4
630 T=T-4
640 PRINT
650 PRINT"DID ANY OF THE ABOVE DIE OF HEART ATTACK OR STROKE"
660 PRINT"BEFORE AGE 60";
670 INPUT A$
680 IF LEFT$(A$,1)="N"THEN PRINTTAB(10)T;"- 0 =";T:GOTO 710
690 PRINTTAB(10)T;"- 2 =";T-2
700 T=T-2
710 PRINT
720 PRINT"WHAT IS THE TOTAL NUMBER OF INCIDENCES OF DIABETES,"
730 PRINT"THYROID DISORDER, BREAST CANCER (WOMEN), DIGESTIVE"
740 PRINT"SYSTEM CANCER, ASTHMA, EMPHYSEMA AND/OR CHRONIC
750 PRINT"BRONCHITIS FOUND IN YOUR PARENTS AND GRANDPARENTS"
760 INPUT A
770 PRINTTAB(10)T;"- 3 X";A;" =";T-3*A
780 T=T-3*A:PRINT
790 GOSUB 3000
800 PRINT" PART II     HEALTH AND DIET"
810 GOSUB 3000
820 PRINT
830 PRINT"HOW MANY POUNDS OVERWEIGHT ARE YOU";
840 INPUT A
850 IF A=0 THEN B=0:GOTO 870
860 B=A/10
870 PRINTTAB(10)T;"-";B;" =";T-B
880 T=T-B
890 PRINT
900 PRINT"HOW MANY PACKS OF CIGARETS DO YOU SMOKE A DAY";
910 INPUT A
920 IF A=0 THEN B=0:GOTO 1000
930 IF A <1 THEN B=2:GOTO 1000
940 IF A=1 THEN B=4:GOTO 1000
950 IF A <1.5 THEN B=5.5:GOTO 1000
960 IF A<2 THEN B=7:GOTO 1000
970 IF A=2 THEN B=8:GOTO 1000
980 IF A <3 THEN B=10:GOTO 1000
990 IF A= >4 THEN B=12:GOTO 1000
1000 PRINTTAB(10)T;"-";B;" =";T-B
1010 T=T-B
1020 PRINT
1030 PRINT"HOW MANY DRINKS DO YOU HAVE EACH DAY";
1040 INPUT A
1050 IF A=0 THEN PRINTTAB(10)T;"- 1 =";T-1:T=T-1:GOTO 1080
1060 IF A <=2 THEN PRINTTAB(10)T;"+ 3 =";T+3:T=T+3:GOTO 1080
1070 IF A >2 THEN PRINTTAB(10)T;"- 8 =";T-8:T=T-8:GOTO 1080
1080 PRINT:E$="DO YOU WANT AN EXPLANATION OF THIS":PRINT E$;
1090 INPUT A$
1100 IF LEFT$(A$,1)="N" GOTO 1170
1110 PRINT
1120 PRINT"MODERATE DRINKING (UP TO TWO DRINKS PER DAY) REDUCES"
1130 PRINT"STRESS AND AIDS DIGESTION. HEAVY DRINKING, HOWEVER,"
1140 PRINT"PRODUCES PHYSIOLOGICAL DAMAGE. AS FOR TEETOTALERS,"
1150 PRINT"THEY MAY HAVE RATHER RIGID VALUE SYSTEMS AND MAY"
1160 PRINT"UNDERGO STRESS IN MAINTAINING THEM."
1170 PRINT
1180 PRINT"DO YOU EXERCISE MODERATELY — JOG, BIKE RIDE,TAKE"
1190 PRINT"LONG WALKS, SWIM — AT LEAST 2 OR 3 TIMES A WEEK"
1200 INPUT A$
1210 IF LEFT$(A$,1)="N"THEN PRINTTAB(10)T;"+ 0 =";T:GOTO 1230
1220 PRINTTAB(10)T;"+ 3 =";T+3:T=T+3
1230 PRINT
1240 PRINT"HOW MANY HOURS DO YOU SLEEP EACH DAY";
1250 INPUT A
1260 IF A <9 THEN PRINTTAB(10)T;"- 0 =";T:GOTO 1290
1270 IF A=9 THEN PRINTTAB(10)T;"- 4 =";T-4:T=T-4:GOTO 1290
1280 IF A= >10 THEN PRINTTAB(10)T;"- 6 =";T-6:T=T-6
1290 PRINT:PRINT E$;
1300 INPUT A$
1310 IF LEFT$(A$,1)="N" GOTO 1360
1315 PRINT
1320 PRINT"ADULTS THAT SLEEP TOO MUCH USE TOO MANY HOURS"
1330 PRINT"IN NONPHYSICAL ACTIVITY AND MAY BE UNHAPPY AND"
1340 PRINT"SLEEP AS AN ESCAPE OR MAY BE ILL. DEPRESSED"
1350 PRINT"PEOPLE HAVE SHORTER LIFE EXPECTANCIES."
1360 PRINT
1370 IF LEFT$(S$,1)="F"ANDAY <=300R LEFT$(S$,1)="M"ANDAY <=40GOTO 1490
1380 IF LEFT$(S$,1)="M" GOTO 1440
1390 PRINT"DO YOU HAVE A BREAST EXAMINATION AND PAP SMEAR"
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1395 PRINT"AT LEAST ONCE A YEAR";
1400 INPUT A$
1410 IF LEFT$(A$,1)="N"THENPRINTTAB(10)T;"+ 0 =";T:GOTO 1420
1415 PRINTTAB(10)T;"+ 2 =";T+2:T=T+2
1420 PRINT
1430 GOTO 1490
1440 PRINT"DO YOU HAVE A PHYSICAL AND PROCTOSCOPIC EXAMINATION"
1445 PRINT"AT LEAST ONCE A YEAR";
1450 INPUT A$
1460 IF LEFT$(A$,1)="N"THENPRINTTAB(10)T;"+ 0 =";T:GOTO 1480
1470 PRINTTAB(10)T;"+ 2 =";T+2:T=T+2
1480 PRINT
1490 GOSUB 3000
1500 PRINT" PART III     EDUCATION AND OCCUPATION"
1510 GOSUB 3000
1520 PRINT
1530 PRINT"STARTING FROM FIRST GRADE, WHAT ARE THE TOTAL"
1540 PRINT"NUMBER OF YEARS YOU ATTENDED SCHOOL";
1550 INPUT A
1560 IF A <12 THEN PRINTTAB(10)T;"- 2 =";T-2:T=T-2:GOTO 1600
1570 IF A <14 THEN PRINTTAB(10)T;"+ 0 =";T:GOTO 1600
1580 IF A <17 THEN PRINTTAB(10)T;"+ 1 =";T+1:T=T+1:GOTO 1600
1590 IF A= >17 THEN PRINTTAB(10)T;"+ 3 =";T+3:T=T+3
1600 PRINT:PRINT E$;
1610 INPUT A$
1620 IF LEFT$(A$,1)="N"GOTO 1650
1625 PRINT
1630 PRINT"ALTHOUGH ATTENDING SCHOOL DOES NOT MAKE YOU LIVE"
1640 PRINT"LONGER, MORE EDUCATION CORRELATES WITH INCREASED"
1642 PRINT"INCOME, OPPORTUNITY AND ACCESS TO BETTER HEALTH"
1645 PRINT"CARE."
1650 PRINT
1660 PRINT"IS YOUR OCCUPATION CLASSIFIED AS PROFESSIONAL";
1670 INPUT A$
1680 IF LEFT$(A$,1)="N" GOTO 1730
1690 PRINT"ARE YOU A MUSICAN, ARCHITECT OR PHARMACIST";
1700 INPUT A$
1710 IF A$="N"THENPRINTTAB(10)T;"+ 2 =";T+2:T=T+2:GOTO1780
1720 PRINTTAB(10)T;"- 1 =";T-1:T=T-1:GOTO 1780
1730 PRINT"DO YOU WORK IN RUGGED HEAVY WORK OR AS A COOK,"
1735 PRINT"CHEF OR BAKER";
1740 INPUT A$
1750 IF LEFT$(A$,1)="N" GOTO 1770
1760 PRINTTAB(10)T;"-2=";T-2:T=T-2:GOTO 1780
1770 PRINTTAB(10)T;"+0=";T
1780 PRINT:PRINT E$;
1790  INPUT A$
1800 IF LEFT$(A$,1)="N" GOTO 1880
1805 PRINT
1810 PRINT"PROFESSIONALS USUALLY LIVE LONGER EXCEPT MUSICIANS,"
1820 PRINT"ARCHITECTS AND PHARMACISTS. WHY THIS IS TRUE IS"
1830 PRINT"UNKNOWN AT THE PRESENT TIME. YOU HAVE A GREATER"
1840 PRINT"CHANCE OF BEING INVOLVED IN AN ACCIDENT IF YOU"
1850 PRINT"WORK AT RUGGED HEAVY LABOR. PEOPLE WHO WORK AT"
1860 PRINT"JOBS ASSOCIATED WITH OVEREATING ALSO HAVE A LOWER"
1870 PRINT"LIFE EXPECTANCY."
1880 PRINT
1890 PRINT"IS YOUR ANNUAL INCOME OVER $40,000";
1900 INPUT A$
2000 IFLEFT$(A$,1)="N"THENPRINTTAB(10)T;"- 0 =";T:GOTO 2020
2010 PRINTTAB(10)T;"- 2 =";T-2:T=T-2
2020 PRINT:PRINT E$;
2030 INPUT A$
2040 IF LEFT$(A$,1)="N" GOTO 2070
2045 PRINT
2050 PRINT"PEOPLE WITH HIGHER INCOMES USUALLY EXPERIENCE MORE"
2060 PRINT"STRESS EARNING THEM AND CONSUME MORE RICH FOOD."
2070 PRINT
2080 PRINT"IS YOUR JOB ACTIVE OR SEDENTARY"
2090 INPUT A$
2100 IF LEFT$(A$,1)="A"THENPRINTTAB(10)T;"+ 3 =";T+3:T=T+3:GOTO2120
2110 PRINTTAB(10)T;"- 3 =";T-3:T=T-3
2120 PRINT
2130 IF AY <61 GOTO 2180
2140 PRINT"ARE YOU STILL WORKING";:INPUT A$
2150 IFLEFT$(A$,1)="N"THENPRINTTAB(10)T;"+ 0 =";T:GOTO 2170
2160 PRINTTAB(10)T;"+ 2 =";T+2:T=T+2
2170 PRINT
2180 GOSUB 3000
2190 PRINT"PART IV     LIFESTYLE"
2200 GOSUB 3000
2210 PRINT
2220 PRINT"DO YOU LIVE IN A RURAL OR AN URBAN AREA";
2230 INPUT A$
2240 IFLEFT$(A$,1)="R"THENPRINTTAB(10)T;"+ 1 =";T+1:T=T+1:GOTO2260
2250 PRINTTAB(10)T;"- 1 =";T-1:T=T-1
2260 PRINT
2270 PRINT"ARE YOU MARRIED OR LIVING WITH SOMEONE ON A "
2280 PRINT"PERMANENT BASIS";
2290 INPUT A$
2300 IFLEFT$(A$,1)="Y"THENPRINTTAB(10)T;"+ 3 =";T+3:T=T+3:GOTO2360
2310 A=AY-25
2315 IF A <=0 THEN A=0:GOTO 2350
2320 PRINT"HOW MANY OF THE PAST";A;"YEARS WERE YOU SINGLE";
2330 INPUT A
2340 A=A/10
2350 PRINTTAB(10)T;"-";A;"=";T=A:T=T-A
2360 PRINT
2370 PRINT"ON A SCALE OF 0 TO 3, HOW MUCH OF A CALM, PASSIVE"
2380 PRINT"PERSON ARE YOU (3 IS THE MOST CALM)";
2390 INPUT A
2400 PRINTTAB(10)T;"+";A;"=";T+A:T=T+A
2410 PRINT
2420 PRINT"ON A SCALE OF 0 TO 5, HOW MUCH OF AN AGGRESSIVE,
2430 PRINT"INTENSE AND COMPETITIVE PERSON ARE YOU (5 IS THE"
2440 PRINT"MOST AGGRESSIVE, INTENSE AND/OR COMPETITIVE)";
2450 INPUT A
2460 PRINTTAB(10)T;"-";A;"=";T-A:T=T-A
2470 PRINT
2480 PRINT"DO YOU USE YOUR CAR'S SEAT BELTS AND FOLLOW SPEED"
2490 PRINT"LIMITS REGULARLY";
2500 INPUT A$
2510 IFLEFT$(A$,1)="N"THENPRINTTAB(10)T;"+ 0 =";T:GOTO 2530
2520 PRINTTAB(10)T;"+ 1 =";T+1:T=T+1
2530 PRINT
2540 PRINT"ON THE FOLLOWING SCALE HOW WOULD YOU RATE YOURSELF?"
2545 PRINT
2550 PRINT"          HAPPY: 3 2 1 0 -1 -2 -3 :UNHAPPY"
2560 PRINTTAB(12);
2570 INPUT A
2580 IF A = >0 THENPRINTTAB(10)T;"+";A;"=";T+A:T=T+A:GOTO 2600
2590 PRINTTAB(10)T;A;"=";T+A:T=T+A
2600 PRINT:PRINT
2610 GOSUB 3000
2620 PRINT"          YOUR LIFE EXPECTANCY IS";T;"YEARS"
2630 GOSUB 3000
2640 PRINT:PRINT:PRINT
2999 END
3000 FOR X=1 TO 59:PRINT"-";:NEXT X:PRINT"-":RETURN
OK
```

We Have GOOD NEWS and BAD NEWS

The good news is that you can now add any S-100 bus compatible component to The VERSATILE CRT.

The bad news is you'll have to decide for yourself what components will combine to make the best system for you.

Just by looking you can see it's a rugged, professional unit with a 9" video monitor covered with smoked plexiglass, and a 53-key ASCII keyboard.

But there's more than meets the eye. What you can't see is the mainframe which is a 10-slot plexiglass card rack. Or its fully shielded motherboard with 10 spaces provided for sockets (2 sockets are already included for you). Or the heavy duty filtered power supply and 75 CFM cooling fan. Or the power switch and cord on the rear panel. Or the space available for a floppy disk system. Or the expansion capabilities on the back panel for the addition of sockets.

You'll receive The VERSATILE CRT fully assembled with a 90-day warranty, about 20 days after we get your order. Or you can buy one at your nearest dealer. Dealers can have super fast delivery from stock to 20 days. You'll also receive complete documentation and operating manual. Total price for The VERSATILE CRT is $699.95.

Dealer inquiries are welcomed.

Compact and Expandable, The VERSATILE CRT lets you do it your own way.

COMPUTER DATA SYSTEMS

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Photo 1. Layer one — keyboard, UART, power supply.

Photo 2. Layer two — parallel solenoid driver card.

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Consider a MITE Printer

. . . alternative to the ASR-33

A low-cost impact printer (not dot matrix) is something we've all been looking for. At $276 the MITE-Expandor may start showing up in a lot of places.

Ralph makes several references to special forms for use with the printer. We have an upcoming article that will discuss the different small-business forms that are available for printers — John.

There is something satisfying about the noisy, overworked, ASR-33 TTY machine as an input/output device for microcomputer systems. One aspect is high reliability, well beyond its recommended useful lifetime. A similar but more compact and much lower cost printer with full 80-column width has been in use as a portable communications terminal (PORTACOM), and also in various military airborne RTTY systems. This is the MITE printer made by the MITE Corporation of New Haven CT. Previously, the printer mechanism has only been available to OEM users.

Recently, Expandor Inc., 612 Beatty Road, Monroeville PA 15146, has made a bare-bones version of the model 123P MITE, along with a parallel/solenoid driver interface card available to microcomputer users, all for $276. With this printer mechanism, a standard ASR-33 keyboard and a UART serial adapter board, a stand-alone printer can be fabricated for a parts cost of $375 or less. Such a serial terminal unit is about as noisy without any covers as an ASR-33, but has the satisfying clunking noises of a well-designed mechanical device that operates at standard 110 BPS rates. The MITE printer is capable of printing all 64 characters of the ASCII dense sub-set on friction or sprocket feed paper. Beautiful carbon copies can be obtained because the print drum is located behind the paper with a hammer mechanism striking the ribbon in front (see example of carbon copy of printer output).

Layer one of the terminal consists of a power supply, a UART serial adapter board, and a standard ASR-33 style keyboard, all assembled on the bottom frame of an old portable typewriter case (see Photo 1). Layer two is the parallel/solenoid driver interface card, which is driven from 5 V TTL but has a built-in 110 V dc supply to drive the solenoids on the MITE 123P (see Photo 2). Layer three is the printer mechanism and paper transport (see Photo 3).

Theory of Operation

The printer is rugged and operates on a closed loop solenoid positioning system which positions a set of six solenoids for rotary motion of a print drum and another set of six for lateral drum position. There are no return springs for the solenoids; a logic 0 and 1 are applied to

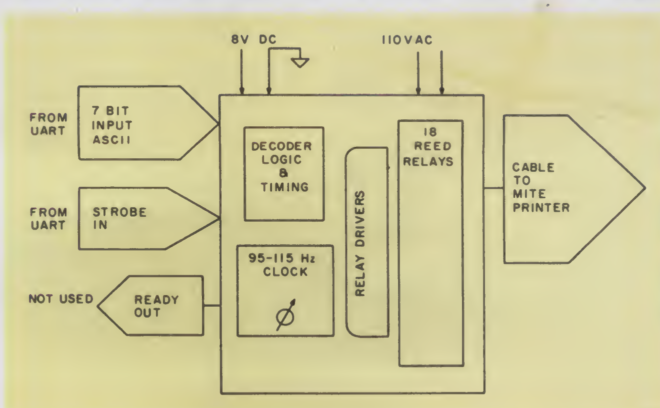


Fig. 1. Expandor parallel interface board block diagram.

Photo 3. Layer three — MITE-Expandor printer mechanism.

solenoid pairs for positive, reliable print head positioning. Additional solenoids provide drum lock, character advance, carriage return, line feed, ribbon feed, and print command. The parallel interface card, designed by Expandor Inc. (see Photo 2 and Fig. 1) drives all the solenoids from a standard ASCII 7 data line and a key-pressed strobe (see Fig. 2 for chart of ASCII codes). The interface also has a data ready output. The strobe input can be jumpered to print either on a positive or negative-going edge. The ready line output can be similarly strapped to provide position or negative enable signals to external devices if desired. The interface card requires 8 V raw dc at about 750 mA maximum, and has a built-in LM309K 5 V regulator. The solenoid power is an additional 750 mA maximum, but obtained directly from rectified 110 V ac line switched through isolating dry-reed relays driven by the 5 V TTL parallel interface card. The driver circuitry is inherently limited to 110 BPS as in standard ASR-33 equipment.

Accessories

A complete (military style) mechanical servicing manual comes with the MITE printer. They suggest a 250-hour or six-month oiling and operational inspection, and a 1500-hour overhaul (similar to the recommendations given for an ASR-33 TTY). The printer looks as if it will give a lot of service — time will tell. When it arrived (about 3½ months late due to some parts problems at Expandor, which are now solved), the print hammer struck a bit too hard. However, detailed adjustment methods given in the printer manual allow the user to adjust any part of the mechanism by carefully following instructions.

The *printer* uses standard 8½ inch wide paper with sprocket hole punches every ½ inch. A pressure roller drive is a standard feature allowing use of 8 inch or narrower strips of paper, including carbon copies. A pin-prick adapter sprocket is also available from MITE. Expandor does not say anything in their literature about availability or price of special oil and grease mentioned in the MITE service manual, but they do sell extra ribbons, and standard paper at about 1¢ per page in continuous 1000-page gatefold, sprocket-hole packages. We store 100 sheets or so of paper in a fiberboard expandable envelope glued to the typewriter case top cover. This feeds paper directly into the printer with no difficulty.

Interface

The serial interface adapter (Fig. 3 and Photo 1) is straight out of Lancaster's *TVT Cookbook*, but optical

ROTARY MOTION

									b6	b1	b2
	#	3	+	;	'	7	/	?	I	I	I
	!	1	)	9	%	5	—	=	I	I	O
	″	2	*	:	&	6	.	>	I	O	I
	■	Ø	(	8	$	4	,	<	I	O	O
	C	S	K	[	G	W	O	←	O	I	I
	A	Q	I	Y	E	U	M	]	O	I	O
	B	R	J	Z	F	V	N	↑	O	O	I
	@	P	H	X	D	T	L	/	O	O	O
b3	O	O	O	O	I	I	I	I			
b4	O	O	I	I	O	O	I	I			
b5	O	I	O	I	O	I	O	I			

LATERAL MOTION

Fig. 2. Chart showing ASCII codes available on MITE printer.

Photo 4. Checking out the UART and keyboard.

isolators were added for use with the 20 mA current loop ports of KIM in my system. This prevents printer powerline noise from upsetting the computer or vice versa. The only feature lacking is a paper tape reader and punch common to many ASR-33 units. However, the KIM and many microcomputer systems have a cassette tape interface, which serves just as well in most applications.

The MITE printer mechanism sometimes has missed printing a character, particularly after a CRLF and the first column of the next line is caught on the fly between characters. This also happens sometimes with ASR-33 machines. Another problem we found with KIM is that a failure to use the reset and rubout commands prior to using the terminal often results in a few missed characters because KIM has not had a chance to exactly match the speed of the external clock in the UART adapter board. Particularly, this happens when both computer and terminal have been turned on but are not being used. So, it is a good idea to always initialize the terminal with a fresh rubout command to KIM to take care of any clock drift between uses of the terminal. A synchronous UART clock derived from the KIM 1 MHz crystal would probably take care of this problem in place of using a simple 555 oscillator on the UART adapter board.

Ribbons and Forms

When a new ribbon is first used, the print will be very dark and often somewhat blurred until the ribbon wears off the fuzz on the printing side. This may take 25 pages or so of copy before the lines become sharp. On the other hand, this drum-behind-the-paper method has the advantage of always producing very sharp carbon copies (see Fig. 4). We have tried up to three carbon copies as might be used in printing invoices on rather thin paper. A problem with carbon copy is inserting the paper properly for pressure roll drive, to avoid jamming. Specially made carbon copy paper with sprocket holes is available from some business form and office supply firms. Another type of (more expensive) copy paper is the impact printing type with the ink already imbedded in the paper.

A Few Problems

KIM and Tiny BASIC: The first model of the Expandor parallel interface decoding board was designed for terminal use without paper tape reader-punch. The rubout command for a conventional ASR-33 keyboard is not uniquely decoded so that operation of either the shifted ?/ key or RO both produce a printed ? symbol. This can be annoying to KIM-1 owners when RO is used to initialize the serial I/O port. The problem is that either all 6 or all 7 bits produce a ? command. This is also of concern in using Tiny BASIC by Pittman, where the pad delay character is normally all 1s RO. Location X011 in Tiny BASIC should be changed from a (hex)82 to a (hex)02 for KIM with the MITE-Expandor printer terminal. The pad character then becomes a nonprinted null, or all zeros.

Rubout-question mark fix: Professor Hal Clock of Ohio University has suggested a hardware fix for the rubout-question mark problem as shown in Fig. 5. The control line for all printing is inhibited for bits 6 and 7, preventing printing of a ? symbol on operating the RO key. Expandor is also working up a fix for those users who need the RO key in their system.

Cassettes with Tiny BASIC: Another fact of life in using the terminal without a tape-punch-reader is in saving BASIC programs. This problem is solved by using zero page locations 0020 to 0023 where the low and high address of the memory locations used in a particular BASIC program are found. These locations may be entered in the KIM tape cassette dump routine to preserve the program, along with saving locations 0020 through 0027 to preserve the program status.

Parity error character: The printed ■ character for parity

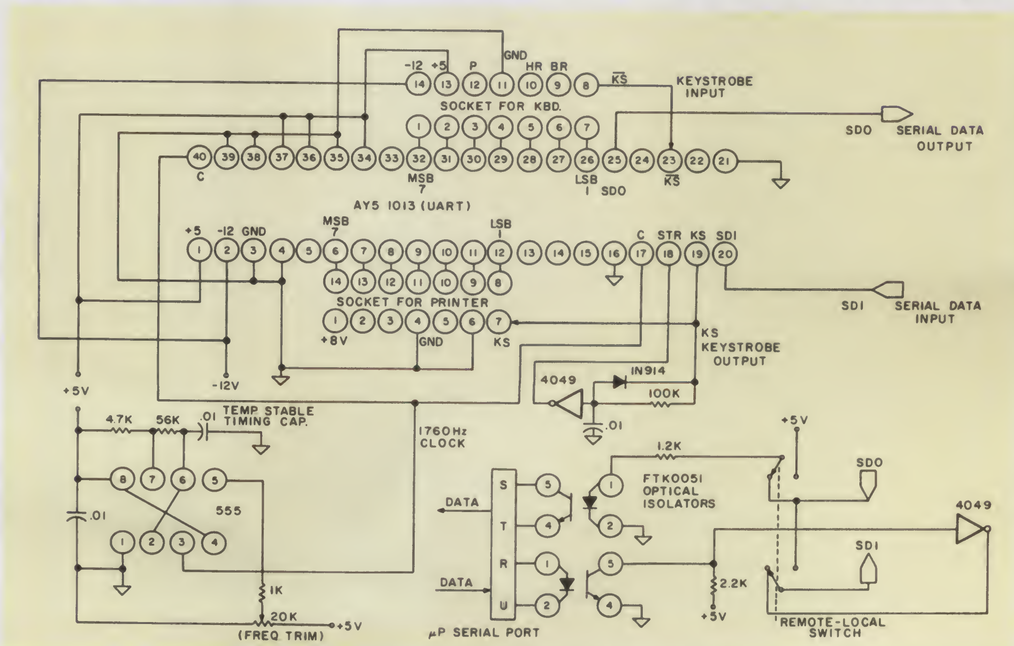


Fig. 3. Partial wiring diagram of serial interface adapter board (also see Photo 1).

error is on the MITE printer drum, but not accessible from the parallel interface because this is printed for an ASCII 0100000, which is decoded as a space with printing inhibited. A decoding fix would have to be devised for those who wish to use this character with an added 8-bit parity error system.

Printer clock: When the printer first arrived, the 555 clock part of the parallel card was set for 97 Hz. There was no discussion in the early manual of this, and I had to puzzle over the circuit diagram furnished to figure out that the trimpot on the interface board had to be adjusted to match the speed of the UART in my serial adapter board. The interface is capable of operating from about 95 Hz to 115 Hz, corresponding to 9.5 to 11.5 characters per second, with 10 characters per second or a 100 Hz internal clock recommended. Thus, one should set his UART clock for a nominal 1760 Hz or 16 x 110 for a normal 110 baud, 10 character per second input rate, and the printer interface card clock should be set at about 100 Hz.

Hardware Failures: A major problem I had with the interface was an early failure of the dry reed relay armature for the space or character advance relay. This created all sorts of problems in blowing fuses on the interface card. Fortunately, fuses are installed on the interface card to protect against these catastrophic failures. The relay armature is sealed in a glass tube that had been soldered in place under tension. When it failed, the glass popped up to reduce the tension caused by poor assembly or a board-warp problem. Military and airborne hardware manufacturers always assemble boards with these reed relays by heating both ends of the relay mount simultaneously, such that they cool in place when the solder solidifies with a uniform position and no tension displacement tendency.

There are 18 relays on the Expandor interface board. It turns out there is an extra one, originally intended for the ribbon feed solenoid. But the board design had been slightly changed by Expandor in this first model, so that the space command and ribbon feed are operated from the same relay, as suggested in

```
THIS IS A SAMPLE OF THE MITE 123P PRINTER OUTPUT
(WITH ONE CARBON COPY)

NOW IS THE TIME FOR ALL GOOD COMPUTERS TO SHAPE UP••••••••••••••••••••••••••••••
THE QUICK BROWN FOX JUMPED OVER THE LAZY DOGS BACK 1234567890 TIMES•••••••••••••

12345678901234567890123456789012345678901234567890123456789012345678901234567890
(80 COLUMNS)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890!"#$%&'()*=:-←@[\+;↑]<>?/.•
(ASCII 64 CHARACTER SET)

R. W. BURHANS   6/20/77       (PARTICULARLY NOTE SHARPNESS OF CARBON COPY!)
```

Fig. 4. Sample output (carbon copy!).

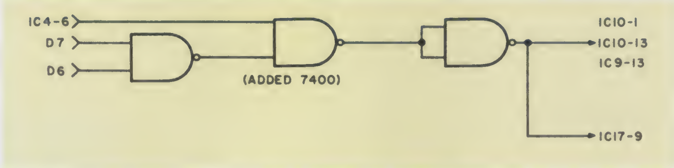


Fig. 5. Modification of Expander parallel interface board for ? fix. Break line from pin 6 of IC4 (¼7400) going to IC17 etc. but not to IC5. Substitute above with D7, D6 obtained from 7475 latch. Also necessary to break clear of 7474 delay shift registers IC9, 10 and clear with this same signal. This mod prevents printing of any character with both D6 and D7 bits on (circuit suggested by Hal Clock, Ohio University).

(Program first published in Byte, *Vol. 2, No. 4, April 1977, Richard Rosner, author.)*

```
10 INPUT X
20 LIST1000,1010
30 IFX=1GOTO100
40 IFX=2GOTO200
50 IFX=3GOTO300
100 END
200 INPUT T,V
205 X=T
210 PR"X","Y"
215 PR"----","----"
220 GOSUB1000
230 PRX,Y
240 X=X+5*V
250 IFX<T+55*VGOTO220
270 IFY<0GOTO490
290 END
300 INPUT T,V,U,W
310 PR
320 PR"  Y =",U,"","",U+25*W,"","",U+50*W
330 PR"","!         ●         !         ●         !         ●         !         ●         !         ●         !      "
340 PR"    X=      ------------------------------------------------      "
350 X=T
360 GOSUB1000
365 Y=(Y-U+W/2)/W
370 IFY<0GOTO490
375 IFY=0GOTO500
380 PR"    ";X,"I";
390 IFY<=50GOTO430
400 PR
410 GOTO510
430 Y=Y-1
440 IFY=0GOTO470
450 PR" ";
460 GOTO430
470 PR"+"
480 GOTO510
490 PR"    ";X,"<"
495 GOTO510
500 PR"    ";X,"+"
510 X=X+V
520 IFX<T+51*VGOTO360
590 END
1000 REM THE EQUATION TO BE PLOTTED IS
1010 Y=X*X*X/10
1999 RETURN
```

Program A. Tiny BASIC plotting program.

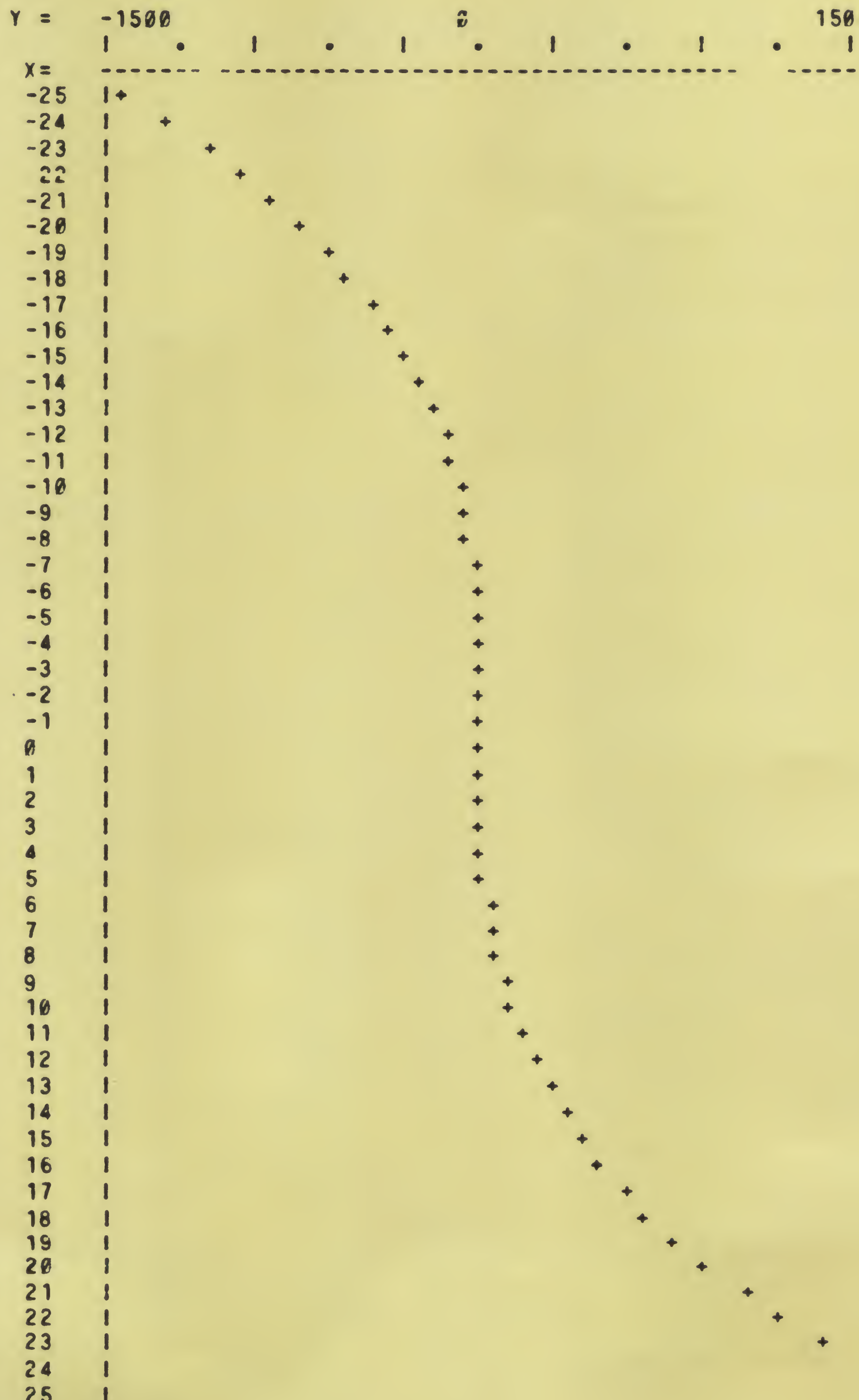
the MITE mechanical service manual. Anyway, I ended up substituting the unused ribbon relay to drive the space and ribbon solenoids in parallel. However, this created a new problem in cross talk back to the print strobe lines, which are close to this extra relay. This was cured by adding a .01 uF low pass filter capacitor from pin J6 to ground (the jumper connection for reversing the strobe input) on the Expandor board. I spent a frustrating weekend during the midwest heat wave in July (around the time of the New York blackout of 1977) debugging this noise problem. I was ready to chuck the whole mess, but cooled down to realize that this was Expandor's first cut, and actually the problem is relatively minor. Expandor has since changed board design, and now also has available a complete serial interface board unit that should have no problems compared to my kludge of home brew hardware.

Summary

In general, I have been very pleased with this terminal system. The printer is at least as rugged as an ASR-33, and the interface card made by Expandor Inc. appears to work reasonably well. The limitations are mostly in my particular keyboard-serial adapter-computer system and not in the basic printer mechanism. The speed limitation, compared to more modern (and usually more expensive) printers, is probably an advantage for those of us who have not graduated beyond the $4K stage. The sound level might be objectionable to some, but this can be reduced with a suitable cover. Expandor sells a molded plastic cover that fits directly over the printer for an additional $29.95. This provides a much quieter machine with a more contemporary look, compared to the antique appearance of my assembly. ■

```
?
KIM
2003 4C G
:RUN3,-25,1,-1500,60

1000 REM THE EQUATION TO BE PLOTTED IS
1010 Y=X*X*X/10+X*X/4+X
```




```
:
```

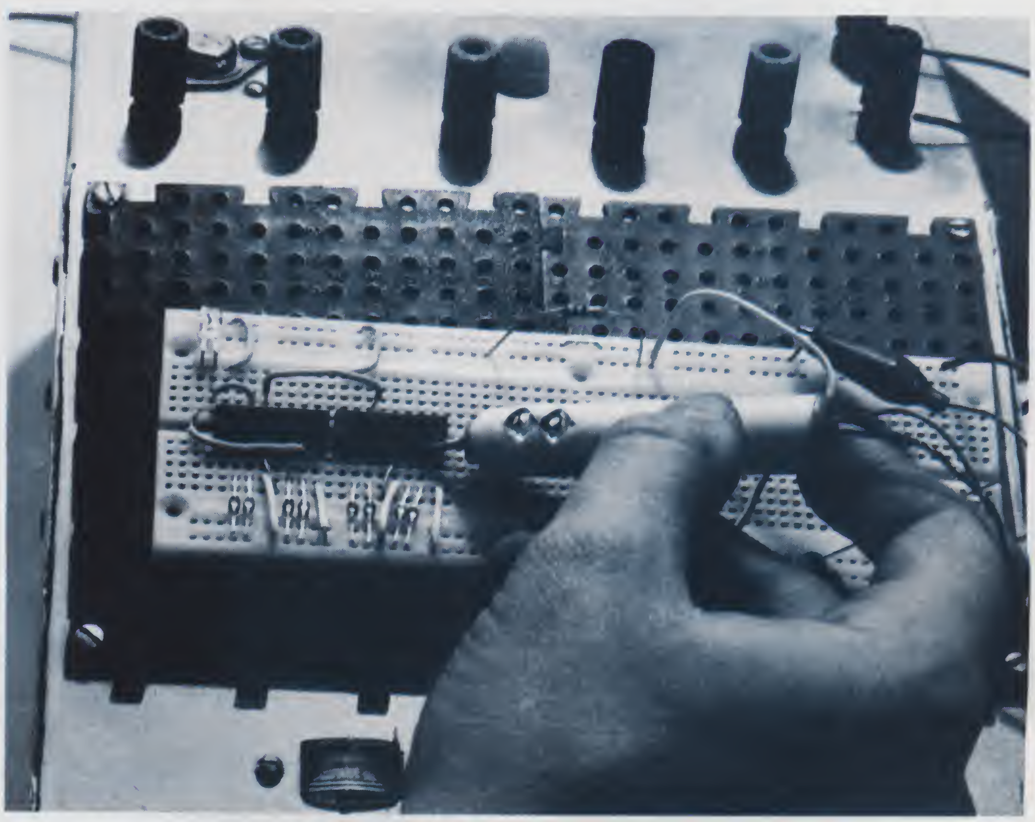
Sample run of Program A.

(My example using Rosner's program.)

Tired of Substituting Chips?

... probe your problems

Pat O'Connor
6315 W. Raven
Chicago IL 60646

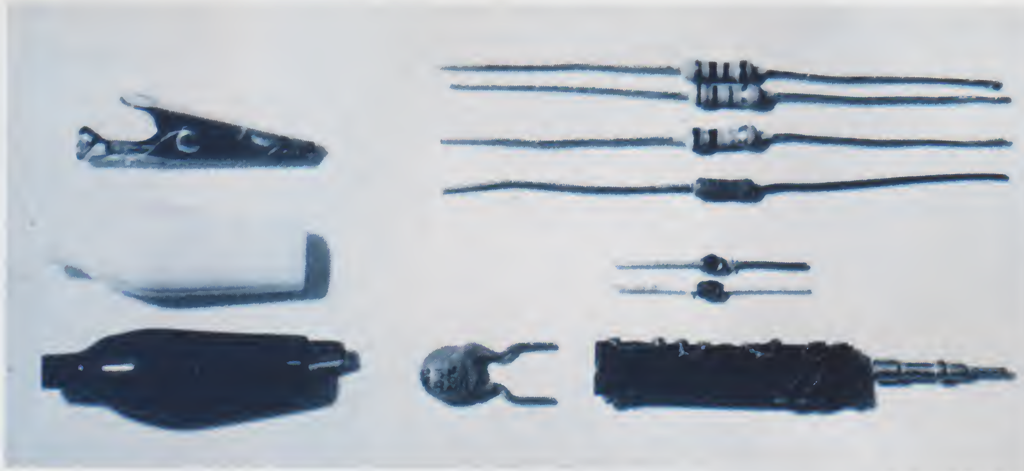


The logic probe in use. The clips are attached to Vcc and ground for the circuit being tested.

This looks like one of those fun projects we all enjoy. Pat pointed out after the article was finished that the probe could also be used as a signal injector by putting a shorting switch across the 1k resistor. — John.

For less than $5 you can build a test instrument that can tell you "everything you ever wanted to know about integrated logic, but were too discreet to ask."

What can you build for less than five bucks? You can build a logic probe, which is a test instrument capable of identifying logic levels at various test points in your circuit, and works with TTL logic devices and the TTL-compatible signals available from most microprocessors. You will need to know a little about what the logic probe is supposed to do, how the circuit we use will make these things happen, how to build the probe, and how to use the probe when it is completed.



Components for making the TTL Tri-state logic probe. The ICs are shown with their leads already folded, prepared for the mounting of parts.

What Does It Do?

A digital logic probe is a device designed to display (usually by lighting lamps) the logic level of a point in a circuit. One lamp could be used to represent the high logic level, and another to represent the low. In a minimum circuit, all you need is two lamps, some drive power to light them, and a circuit that can tell the difference between high and low for the type of logic under test.

The most straightforward way to get these requirements for a TTL logic circuit would be to drive the lamps from a circuit which is made of TTL logic devices themselves (Fig. 1). The problem of being able to discriminate between a logic level 1 and a logic level 0 is solved, because the input is a TTL gate; the drive-power requirement is taken care of because any low TTL output is capable of sinking enough current into the circuit ground to light a light-emitting diode (LED) at very nearly its maximum brightness.

Theory of Operation

The circuit of Fig. 1 contains three inverters. When the input of each inverter is high, its output is low, and vice versa. Each LED can light only if its cathode is more negative than its anode by a voltage of about +1.8 V. The high and low output levels from the TTL inverters are about +3.8 V and zero volts, respectively.

In the circuit, the anodes of the LEDs are attached through a 100k resistor to +5 V, and it is the cathode voltage that determines whether the diodes will light or not. When the output of an inverter is attached to the cathode of the LED, a low level will light the LED and a high level will turn it off. The low level is near zero, so it is almost 5 V lower than the +5 V supply. This is enough voltage to light the diode. The high level is only 1.2 V lower than the +5 V supply, and is not enough to light a diode attached to the output. Gate a will be low at its output when the probe tip contacts a high logic level, and LED 1

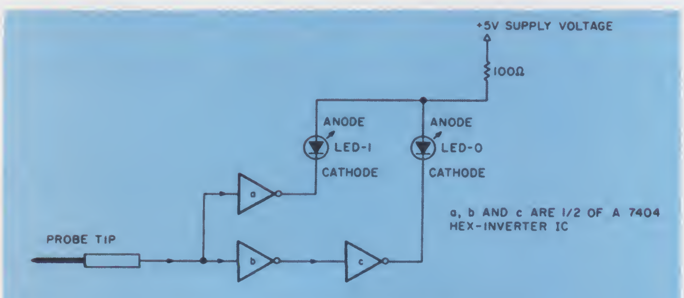


Fig. 1. A minimum logic probe circuit.

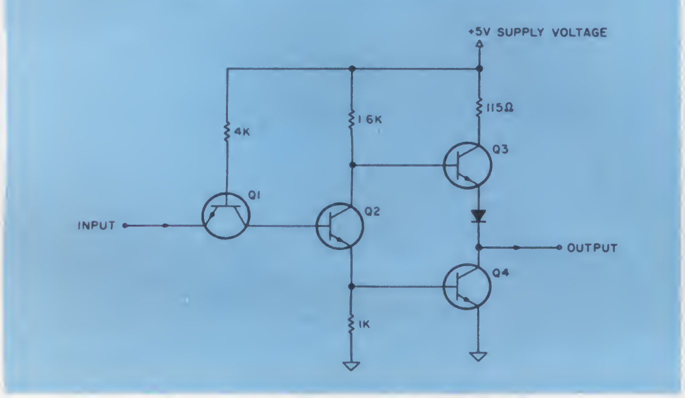
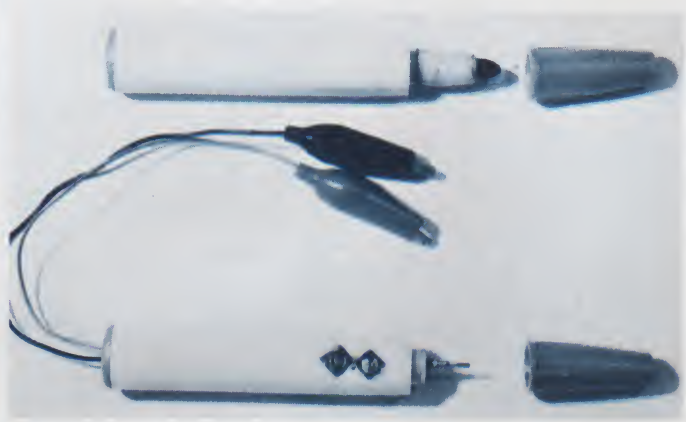


Fig. 2. Internal schematic of a TTL inverter.



The fiber pen has been opened, cleaned out, sawed off and put together with a logic probe inside. The cap was retained as a protective cover for the probe tip.

will light. Gates b and c invert the signal twice; the output of c is high when the probe tip contacts a high logic level, and LED 0 will be off. By similar reasoning, you will get the LED 0 lamp to light and the LED 1 lamp to go out when the probe tip contacts a low logic level. Since TTL gates respond to an input voltage above +2 V as a high logic level, any voltage above a threshold of +2 V should be displayed as a logic 1, and any voltage below that value should be displayed as a logic 0. As a result, we get a reading in which LED 1 is lit when the probe contacts a high, and LED 0 is lit when the probe contacts a low. Apparently, it would seem that this circuit satisfies the needs of a logic probe.

Unfortunately, there is a third possibility. The probe tip may touch a point which is neither a high logic level nor a low logic level. What will happen? Let's examine the input of the TTL gate to see what happens when the probe tip does not contact anything (Fig. 2).

The transistor Q1 is unable to conduct current when its emitter (the input) is disconnected from any contact. That transistor is also unable to conduct any current when its input is attached to a high logic level, because the supply voltage is also a high logic level and current has no direction to go in. When the input is low current can flow through the transistor between the supply and the ground (the low logic level). This leads us to the conclusion that a high logic level and a disconnected input cannot be told apart by the TTL input. The circuit reacts to a disconnected input in the same way as it would to a high logic level at its input.

This means that the logic probe will be reading 1 when nothing is connected to its input. We say that the TTL input is "floating." While this is normal behavior for TTL gates, is it desirable in our logic probe?

A less-than-minimal logic probe should have a display which tells the observer if it is making contact with a floating condition. You should be able to see a third readout when the logic probe is not touching anything.

In Fig. 3 the inputs to the TTL gates, which are floating high, are pulled down periodically by the square wave generator through the 1k resistor. This causes the LEDs to alternate at the square wave frequency. If the frequency is fast enough, the LEDs will appear to be lit simultaneously, but at a lower brightness than before. The 1k resistor was carefully chosen so that the lower portion of the square wave would be barely enough to pull the floating gate inputs below their +2 V threshold. If the probe tip is touched to a legitimate logic 1 in the circuit under test, it will also be pulled down periodically, but not far enough to go below the +2 V threshold. Similarly, when the probe tip touches a logic 0, the high portion of the square wave will pull the signal up a little, but not enough to go over the +2 V threshold and be interpreted as a logic 1. Another way to look at this is to say that the square wave generator and 1k resistor put out enough current to drive the two inverters inside the probe, but not enough to drive three TTL devices, the two in the probe and the one in the external circuit. We can say that the generator has a *fan-out* of two, but not three.

Our logic probe can now indicate three different conditions: LED 1 on indicates a high logic level, LED 0 indicates a low, and both LEDs on at a lower brightness indicates that the probe is not connected to anything. Actually, the third indication may also show a circuit test point where there is a very high impedance between the test point and either Vcc or ground. This condition exists in a family of logic known as Tri-state logic, and is called "floating the outputs." Since the probe tip is effectively disconnected from the rest of the circuit by the high imped-

Another housing for the logic probe. Although it is a tight squeeze, the components can be assembled in a package which fits into the barrel of a Bic four-color pen. There's even some room left over at the end of the barrel.

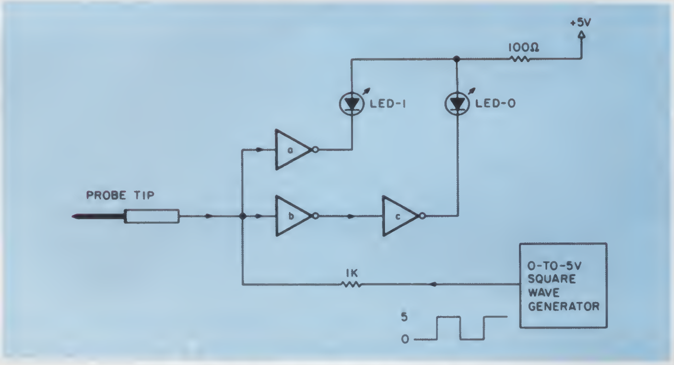


Fig. 3. A Tri-state logic probe circuit.

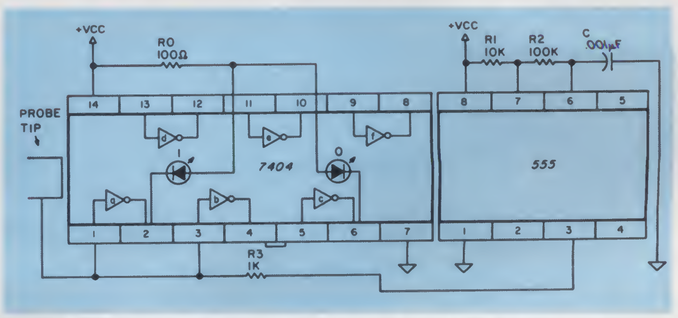


Fig. 4. Complete schematic and parts list for the logic probe.

ance of the output, this state will also be indicated by both LEDs on at diminished brightness.

Construction

Fig. 4 shows the complete schematic of the logic probe, including pin numbers for the ICs and values for the other components. The only component whose value is critical to the circuit is the 1k resistor. The other components can be varied somewhat without significantly altering circuit performance. The 10k, 100k and the capacitor determine the frequency and duty cycle (percent of the time during which the waveform is high) of the square wave generator.

In general, the smaller the value of these components, the faster the frequency. To keep the duty cycle at about 50%, so that both LEDs are equally bright in the high impedance state, R2 should be at least ten times as large as R1. The 100k resistor used as a pull-up for the LEDs may be smaller or larger without significantly altering the brightness of these lamps. A value of 68k would be about the lower limit, though, for the safety of the driving logic.

Of course, you can construct the probe in any way you choose, but if you would like to make as compact a package as the ones shown in the photos, some special tricks will be needed. Rather than using PC connection, direct point-to-point wiring to the IC can shrink package size to dimensions that will fit into a large ballpoint pen barrel (such as a Bic 4-color pen).

LED 1	LED 0	Condition Indicated
OFF	OFF	Insufficient V_{CC}, no V_{CC} or internal short.
OFF	ON	Low logic-state.
ON	OFF	High logic-state.
ON*	ON*	Floating or high-impedance, or no contact.
ON*	OFF	Input, floating high (TTL). (If you can't tell this from a high-logic-state indication, don't worry)
ON	OFF	When not touching any test-point, this is an indication of excessive V_{CC}.
ON* or OFF	OFF or ON*	When not touching any test-point, a weak logic-1 or logic-0 indicates insufficient V_{CC}.

*weak or dim LED indicator.

Table 1. Indications which can be read from the logic probe.

Part of the scheme depicted in Fig. 5 includes folding the IC leads over the DIP package. The 7404 hex inverter and the 555 timer (square wave generator) should be epoxyed together for anchoring and unused pins on both ICs cut off. The pin (whatever is handy for a probe tip point) should be secured to the front of the package. I drilled a small hole (a millimeter or so) in the front of the DIP to accept the end of the pin before epoxying it in place.

Folding the IC leads over the top and bottom of the packages as shown in Fig. 5 prepares the probe for mounting LEDs, resistors and the capacitor. Fig. 6 shows the placement of these parts on the package. A low-wattage soldering iron tip should be used to solder each component to its lead, as indicated in the diagram. Add the wires with the alligator clips after all components have been mounted, and the probe is ready to test.

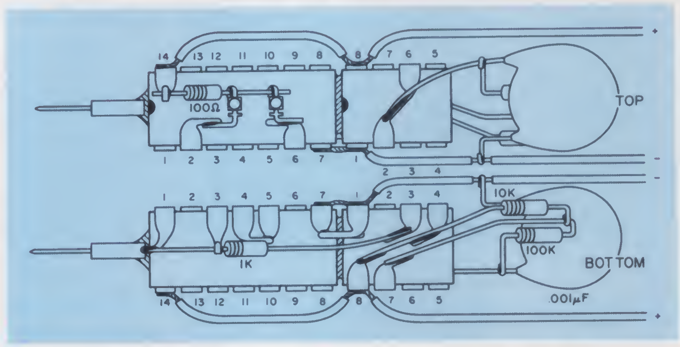


Fig. 6. How to mount components on the IC leads.

Checkout

The positive clip (normally attached to Vcc in the circuit being tested) should be clipped onto a +5 V terminal, and the ground clip to the ground terminal of a dc power supply. When power is turned on, both lamps should light. Bring the probe tip into contact with the + terminal. The LED 1 lamp should get brighter, and the LED 0 lamp should go out. Now, bring the probe tip over to the ground terminal and make contact. The LED 0 lamp should light and the LED 1 lamp go out. Breaking contact with either terminal should result in a readout with both lamps lit. Edge the voltage up slightly (to 6 or 7 volts). The probe, still not touching anything, should switch to a logic 1 indication. This is an indication of excessive Vcc. If your probe has been doing this anyway, when not attached to 1 or 0, the 1k resistor may be slightly off, or the 555 timer may be malfunctioning.

In Conclusion . . .

If everything went as described above, the probe is finished, except for mounting in its case. This will depend on your choice of housing, so I won't attempt to give any directions here. You now have *a test instrument* capable of showing logic 1, logic 0 and open-collector or floating (Tri-state) logic conditions. Table 1 is included to show what indications are possible using the probe. There is actually a fairly large number of things that can be "seen" by the probe in a circuit being tested, some of which do not even *involve* touching a probe tip to a pin. Clipping the probe to Vcc and ground in the circuit being tested, and touching the tip to a foil or IC pin to see what is at that point, is a complete description of the testing procedure. As a super-cheap version TTL tester, this circuit doesn't include the little niceties like pulse-stretching short glitch pulses, or detecting high frequency pulse-trains, but it can still be remarkably useful in checking out the action of almost any TTL, DTL, RTL or other family of logic with positive-logic signals. ■

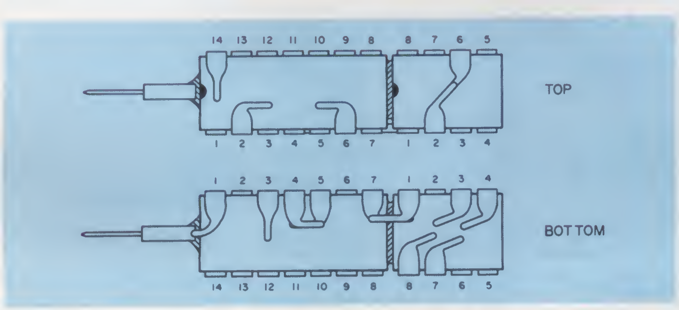


Fig. 5. Diagram for folding IC leads.

THE BASIC FORUM

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efficient the coding is. Lines 20 to 40 form the repeating or iterative calculation. The GRADEs are read one by one from the supplied data, and a running total is kept in SUM. COUNT keeps track of the total number of grades read. The -1 is used to mark the end of data (grades) and trigger the final averaging. Though only three variables are used, the number of grades in a given averaging is not limited to a fixed value. In addition, the DATA statements can be easily viewed for accuracy and necessary corrections made before running the program. In short, the iterative scheme is highly advantageous. Our friend was convinced. His first thought now when faced with a programming problem is how to solve it by "going round in circles" that is, by iteration.

Address any comments or suggestions you might have to:

BASIC Forum
Dick Whipple
P.O. Box 7082
Tyler TX 75711

Next: More about iterative programming.

THE KIM FORUM

from page 17

for $99, with full documentation.

A Confession

I have never claimed to be objective about KIM; she was my first microprocessor love, and I can't seem to leave her. After a three-month absence from MOS Technology, I have rejoined them, and will continue to manage the KIM program for MOS. This is great for me, since I no longer have to feel guilty spending business time talking to people about KIM – it's my job! If you feel that this represents a conflict of interest, write to John and he can fire me!

If you have questions or comments on KIM, you can contact me at MOS Technology, 215-666-7950.

KIM Forum
c/o Rick Simpson
314 Second Ave.
Haddon Heights NJ 08035

LEGAL/BUSINESS FORUM

from page 14

sults.

"At different times, then, a given program is both 'source' and 'object,' both a writing and a mechanical tool or machine part. Printed instructions tell how to do; programs tell how *and* do."

Hersey goes on to offer a social comment based on his objections to the use of the Copyright Law to protect software. He writes, "Progress is progress, and we can guess that we must have all these products of human ingenuity in order to keep one jump ahead of entropy. But a definite danger to the quality of life comes with a blurring and merging of human and mechanical communication."

Hersey concludes that the solution is a proposed "Computer Software Protection Act." Although it differs from the copyright approach, Hersey's proposal seems to me to offer the same rights to the owner of software as the Copyright Law. Those rights raise some philosophical questions in and of themselves.

"Copying" is the exclusive right of the copyright owner. When is a com-

puter program copied? When it is loaded into core or when it is dumped onto a blank cassette?

The software subcommittee believes that the inputting of a program creates a copy. It is, after all, "the fixation of a work in a tangible medium of expression." The repercussions of that conclusion are obvious. Without new statutes, the inputting of a rightfully possessed copy of a program would be an infringement of the copyright. Therefore, the report recommends that a section be added to the Copyright Law that provides that the rightful possesser of a copy of a computer program may make another copy by inputting the program into the computer. It would also provide that a user may prepare a copy for storage as insurance against loss in the event of the destruction of the copy rightfully acquired.

Another exclusive right of a copyright owner is control over the preparation of a derivative work. The conversion of a program from one computer language to another would amount to the preparation of a derivative work. That is the law when you translate a book from English to French (read BASIC for English, COBOL for French?). To be frank, that doesn't sit well with me. But then, I went to business school because I couldn't cope with foreign languages.

The philosophical questions are fascinating. But the bottom line is how do you stop the pirate from copying valuable software. I don't think you can on a hobby level. But is the problem that serious on a hobby level? The recording industry has survived, friends tape recording each other's records notwithstanding. What has to be prevented is the black market mass reproduction situation. That is a police problem. The best laws in the world can't find the pirates, only label them as such.

Unfortunately for the programmer, the nature of the software beast is such that it is difficult to enforce the owner's rights. This state of the art brings to my mind a classic scene in the movie, *The Graduate*. During his graduation party, a friend of the family takes the graduate, Dustin Hoffman, out to the patio and utters the one word that is supposed to guarantee his future success; "Plastics!" That was in the sixties. I say the word today is "Hardware," at least until someone invents a cloning machine.

LETTERS

from page 21

before I've read through the whole thing at least once. Tonight, though, I stopped cold after finishing Dr. Hirschmann's Altair power-supply article (*Kilobaud*, August 1977, pp. 50-54).

I could wax eloquently about the careful detail, the illustrations, the handholding instruction. Instead, I think I'll go back and read Hirschmann's article again.

Suffice it to say it's the best power-supply construction article I've seen anywhere. Anywhere! Can we have some more stuff from Dr. Hirschmann?

Now, let's see, where was I? Ah, yes, "For every Ampere of current drawn, your filter capacitor should have 8000 uF. . . . "

J. Tom Badgett
Bluefield WV 24701

. . . More Comments . . .

On page 50 of the August 1977 issue of *Kilobaud* you have a very fine article entitled "Heavy Duty Altair Power Supply."

Credit is given to the Southern California Computer Society and to the Mijobe Corporation for this design. I take issue with this credit. Vector Graphic, Inc.,

continued on page 51

LETTERS

from page 49

of Westlake Village CA, has had this EXACT design incorporated in their VECTOR 1 and VECTOR 1+ since their inception.

The complete power supply is available direct or from local computer stores at a cost of $60. The transformer (Model VG1-1-022) is available for $30.

As owners of two fine Vector Graphic machines, we feel that credit should be given where credit is due.

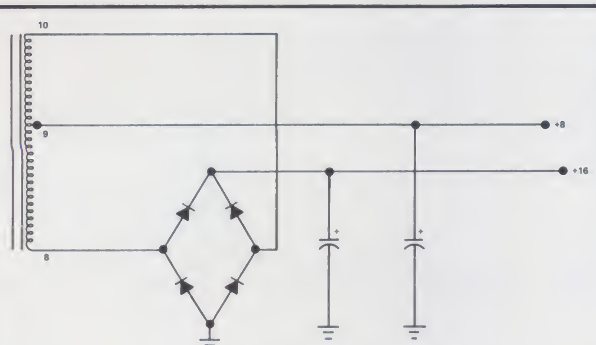
Ed Hall
James Chochos, Jr.
Redwood City CA 94063

. . . And a Reply:

Well, thank you, Tom Badgett, for your fine letter. I hadn't written a technical article before this one, and I was amazed at all the fun I had doing it. With encouragement such as yours, I'll probably write some more. Thanks again.

Now, about giving credit where credit is due. My impression is that Vector Graphic (VG hereafter) might more appropriately give credit to SCCS. Let me explain by giving a brief history of how the SCCS and the VG transformers came about. The original SCCS transformer was designed and manufactured by the Mijobe Corporation at the instigation of Chris Marshall. Chris was a member of SCCS and made these transformers available only to fellow members through group purchase. The design was first delivered in February or March of 1976, and it differed from the one described in my article only in that it had two, rather than three, primary taps. Along with the transformer went a suggested circuit diagram, and this served as the basis for Fig. 1 of my article. My parts values are different in some cases, but the basic circuit is the same. I would also point out that the circuit is a very common one that is not owned by anyone.

The circuit of Fig. 2 is another story. I came up with it on my own but would be surprised if no one else has thought of it before me. I might point out that a variation of this circuit will let you get both +8 and +16 V from the same winding. You do this by connecting terminals 8 and 10 to the ac terminals of a full-wave bridge rectifier. The negative terminal is grounded, and the positive lead of the bridge gives you +16, while terminal 9 of the transformer will give you +8 V. The diagram is shown in Example 1.



Example 1.

In order to set the record straight, let me say that the new SCCS transformer is not the same as the VG unit. The turns ratios, temperature ratings and stack sizes are different, even though they are made by the same manufacturer. As might be expected, even the other parts used in the full kits are different. I haven't checked all parts, but I know the voltage rating for C1 is at least 12 V in the kits supplied by Mijobe, whereas it is 10 V for those supplied by VG. I hope that will clear the air and explain who owes credit to whom.

Rudolf Hirschmann
Pacific Palisades CA

The Home Environment — A Practical Approach

I believe a major piece of hardware has not yet happened that would make microcomputers very realistic in controlling the home. This would be a device through which a computer could turn ac power on and off to selected outlets throughout the home. It would seem to require two parts.

First, a frequency synthesizer, controlled by the computer, with the frequencies transmitted throughout the home over existing ac lines in a fashion similar to that used by "wireless" intercoms.

Second would be small plug-in units that would "listen" to the ac line for a particular frequency. When that frequency is "heard," an ac outlet on this plug-in unit would be switched on or off. Such a device was described by Leslie Solomon in *Popular Electronics* (Aug. '77) using the 567 phase-locked loop as its basis.

The frequency synthesizer could be produced either by hardware or software in the computer; perhaps a music-synthesis program could be modified. The plug-in units would have to be small (the size of a cube tap), physically rugged, cheap ($3) and tunable to any frequency put out by the frequency synthesizer.

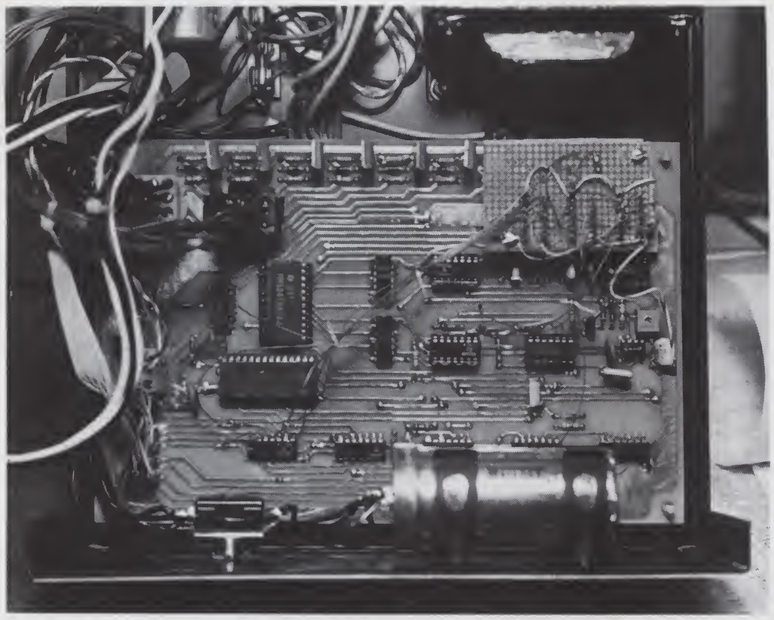
This would be a basic step toward more advanced control of the home, by immediately providing lighting control and the energy conservation that would go along with it. More advanced applications would require the two-way transmission of data between home peripheral and computer — possibly by serially transmitting touch-tone octal over the ac line.

The use of touch-tone would make ham and telephone control of the home and computer possible also. A thermostat, for example, could periodically transmit the temperature at its location to the computer, which could respond by switching on or off heating or cooling elements. This way, the computer could control the temperature in individual rooms, water heaters, ovens, freezers, fire alarms, etc.

Robert Suding has been publicizing this basic theme of computer home control at several computer hobbyist conventions, but has not caught on to the idea of using the ac line to interconnect the computer with the peripheral. Instead, he would rather install separate wiring throughout the home — often impractical in older homes. Interconnections through ac lines provide the ideal method of home control in older homes.

I am afraid that creation of this type of device could produce yet another language in the Babel of baud rates, syncs, buses, Kansas Cities, FSKs, etc., that now is going on with tape cassettes. Home control is so practical that it could sell "computers for the masses" (subject of John Craig's August editorial) by itself. I believe that someone, perhaps *Kilobaud* magazine, should sit down with some engineers, radio amateurs, computer hobbyists, hobby computer manufacturers and *housewives* to devise a system that can perform home control; but more important, to standardize the "quantitative details," the baud rates and the syncs. This would provide for better interchange of systems when home control is made a reality.

Mark Fearon
Barberton OH 44203



The perfboard version of the circuit is mounted in the author's PR-40.

Stretch Those Characters

. . . mods for the SWTP PR-40

Lytle Johnson
8951 W. 46th Place
Wheat Ridge CO 80033

Back in the old days of my 8008 system with limited software and an excellent ROM monitor, handwritten hard copy was tolerable. But a new Digital Group Z-80 with lots of nice software (assembler, disassembler, text editor, BASIC, etc.) made machine-generated hard copy virtually indispensable.

The SWTP PR-40 was chosen because it did what I needed for a reasonable price ($250). Delivery time was three weeks, and two evenings were required to assemble it. Construction was straightforward, and the prepunched chassis and good quality P.C board more than made up for the lack of IC sockets (I put in my own).

Basically the unit is a seven-element solenoid-driven dot generator which prints 5x7 dot-matrix ASCII characters one column at a time. The solenoid head moves across the full width of the paper for each revolution of a plastic cylinder with a helical groove. Thus an entire 40-character line is printed

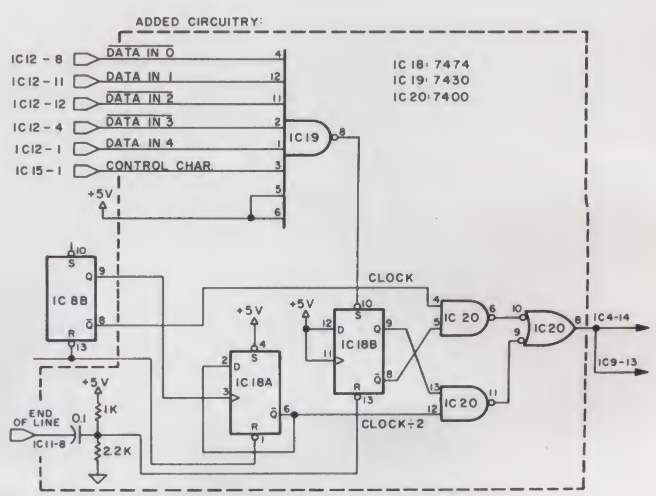
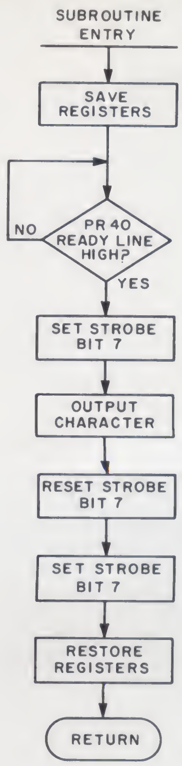


Fig. 1. Schematic of the double-width character modification to the SWTP PR-40 printer.




```
COMMAND=

*Z-80 DISASSEMBLER*
COMMAND=H
COMMAND=S
STADDR=0618
NDADDR=0630
STADDR=
0618 F5       PUSH AF
0619 C5       PUSH BC
061A 47       LD   B,A
061B DB 02    IN   02
061D E6 01    AND  01
061F 28 FA    JR   Z,FA       *061B*
0621 78       LD   A,B
0622 F6 80    OR   80
0624 D3 02    OUT  02
0626 E6 7F    AND  7F
0628 D3 02    OUT  02
062A F6 80    OR   80
062C D3 02    OUT  02
062E C1       POP  BC
062F F1       POP  AF
0630 C9       RET
```

Fig. 2. A single-character output subroutine for the PR-40.

each time the cylinder rotates. A 40x9 FIFO memory buffer stores ASCII characters either until it is full or when a carriage return character is received. The electronics in the printer handle carriage returns decoding, buffer loading, solenoid head movement, buffer dumping to a character generator, and solenoid drivers. A status line can be returned to the computer for maximum speed.

Shortly after completing the printer I decided it would be nice to generate double-width characters just like the bigger Centronics printers. Some thinking and breadboarding produced the following change.

The Hardware Modification

A few moments' thought and one realizes that any dot matrix line printer generating characters one column at a time can be modified to print double-, triple-, or any-width characters. It is only necessary to modify the character generator clocking relative to the print head clocking. Before the bugs were ironed out of this modification, it was possible to print a letter H almost four inches wide. It looked like the world's longest hyphen until you saw the uprights.

A hard-wired double-width character generation scheme was chosen. Fig. 1 is a schematic, the basic idea of which could probably be used on any other printer. The output of IC 8B would normally go directly into the column counter to determine which column of a character is valid. The modification uses another 7474, IC 18A, to divide this IC 8B clock by two so that each column of a character is valid for two print pulses instead of only one. The other half of the 7474 is used as a set/reset flip-flop to control the gates of IC 20. Therefore the state of IC 18B determines which clock (CLOCK or CLOCK ÷ 2) will increment the ROM column counter.

The default state of IC 18B is reset, so that $\overline{Q} = 1$ and CLOCK is selected. This reset pulse is generated at the end of every line of print from IC 11. However, if a 12_{16} is received from the computer, IC 18B will be set so that CLOCK ÷ 2 is selected and double-width characters are printed on the next line. The electronics already ignores any control character (below 20_{16}), so IC 19 could be wired according to personal preference (12_{16} was chosen merely to be symmetrical. That way each input line looks like two TTL loads to the outside world).

The photo shows the placement of the perfboard add-on. Note that the PC board trace between pin 8, IC 8B and pin 14, IC 4, must be cut. An OK hand wire-wrap tool was used. It is a very versatile and easy-to-use gadget with no moving parts to wear out.

Some typical output from the printer is shown in Fig. 2. The print intensity control was turned to approximately midway for these examples, although I normally run mine at the lightest setting to avoid heating the solenoids. Less heat = longer life = less cost, although the printer seems to be built very simply and reliably.

Some Software

Fig. 2 lists a single-character output subroutine in Z-80 language. Any number of characters can be output because the status line is sampled every character via input port 2. Output port 2 is used for the seven ASCII bits plus a strobe bit (bit 7). AND-OR instructions are used to generate the strobe pulse. To print a double-width line merely insert a 12_{16} anywhere in the character buffer. It won't *(can't)* be printed, but the double-width flip-flop will be set. Fig. 3 shows a hexadecimal dump of the character buffer for my "*Z-80 DISASSEMBLER*" heading, with the 12_{16} at 0647 and OD_{16} (CR) at 0648. Keep in mind that twenty characters is the maximum line length when printing double width. ■

```
COMMAND=

*Z-80 DISASSEMBLER*
COMMAND=H
COMMAND=D
STADDR=0634
NDADDR=0654
STADDR=
0634  2A 5A 2D 38 30 20 44 49
063C  53 41 53 53 45 4D 42 4C
0644  45 52 2A 12 0D 20 20 20
064C  20 20 20 20 20 20 20 20
0654  20 20 20 20 20 02 F1 CD
```

*Fig. 3. A character buffer to print "*Z-80 DISASSEMBLER *" double-width.*

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Magnetic Bubble Memory

. . . new technology

Sooner or later everyone in the digital computer field is going to run up against the new magnetic bubble memory (MBM) devices. When this inevitable collision takes place, it will quickly become apparent that most of the material about MBM that is available has been written with your local neighborhood physicist in mind. If you have not yet encountered MBM, take a friendly suggestion and read on — it never hurts to be prepared.

MAGNETIC BUBBLE MEMORY DEVICE CHARACTERISTICS

Useful capacity	92,304 bits
Operating frequency	100 KHz
Average access time	4.0 ms
Average cycle time	12.8 ms
Data rate	50 Kb/sec
Operating temperature	0 to 50°C
Nonvolatile storage range	-40 to 85°C
Package size	1.0 x 1.1 x 0.4 inches
Weight	25 grams
Shielding capacity	40 Oersteds

Fig. 1. One of the new TIB-100 series of magnetic bubble memories from Texas Instruments.

What Are They?

Contrary to popular belief, magnetic bubble memories are not magic. They are nonvolatile memory storage devices that can be viewed as solid-state analogs of rotating electromechanical memories, such as magnetic disks or drums. In all of these devices, information is stored in the form of magnetized regions. In a bubble memory, these regions take the form of cylindrical domains or bubbles in a thin layer of magnetic material. It is the presence or absence of these bubbles at specific locations that corresponds to binary digits stored at those locations. These data bits are made accessible by moving the bubbles within the solid layer to an access device. The data is moved through the storage medium, whereas in a disk the storage medium with the data is moved to the access device.

Bubble Propagation

How you move the data once it is converted into bubbles is the next area to be dealt with. The disks and drums in our analogy use electromechanical devices to rotate the storage medium. The MBM, on the other hand, uses *rotating magnetic fields* to move the bubbles in a thin magnetic sheet. So it can be seen that MBM has no moving parts (mechanical, that is). To control the size of the bubbles, a static magnetic field, called a bias field, is applied to the entire chip. The bubble size is measured in μm (microns), and their sizes currently vary from 1.8 to 5μm in diameter.

Now that the size of the bubble is under control we must provide a path for the bubbles to follow. This is done with patterns of permalloy metal deposited on the thin magnetic sheet. As the magnetic field rotates, the bubbles move through the

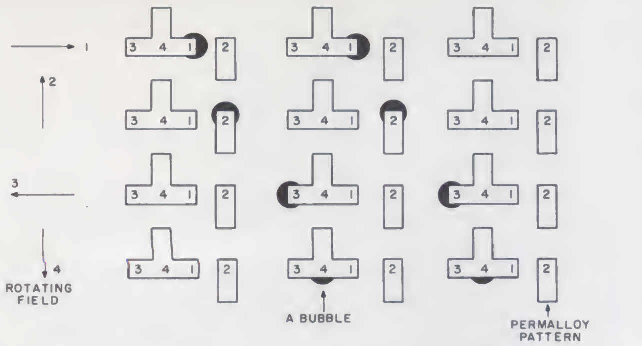

Fig. 1. T1-Bar pattern. As the external magnetic field rotates, bubbles move through the medium controlled by field concentrations created by conductive patterns.

magnetic sheet in shift-register fashion along a path defined by a permalloy pattern. The pattern shown in Fig. 1 (the TI Bar) is the one used by Texas Instruments in their TIB-100 series, which is the first commercially available MBM, and the bubble chip discussed in this article. The rotating magnetic field is provided by surrounding the bubble chip with two orthogonal coils driven 90 degrees out of phase with each other. It is this rotating field that causes the bubbles to move under the permalloy patterns in shift-register fashion.

So, we now have a bubble chip with data stored in it in the form of bubbles that can be moved by rotating magnetic fields like a giant shift register. But, what a shift register! The TIB-100 series can hold 92K bits and represents only the tip of the technological iceberg. Can you imagine a 1M bit shift register? Obviously there must be a better method of handling the data or our access time would be given in millidays. To gain quick access to this super shift register it has been organized into major and minor loops as shown in Fig. 2. Data in the form of bubble domains is written in the major loop and shifted around until it is at the transfer gates adjacent to the minor loops. In the TIB-100 series there are 157 minor loops for the storage of data. A transfer pulse moves data that has been generated in the major loop to the minor loops. This block of 157 bits is called a page, and this particular bubble device can hold 641 pages.

"I've Got Some Good Loops And Some Bad Loops"

The MBM devices are fabricated using fine geometries, which makes the task of manufacturing perfect devices difficult. In order to enhance production yields and achieve correspondingly lower costs, a maximum of any 13 of the 157 minor loops on the chip are allowed to be defective. The remaining 144 good loops are used for data storage, allowing a storage capacity of 92K bits. The defective loops are determined at final test, and a map of these loops is supplied to the end user so that the defective loops may be masked out in the memory system.

Since any 13 of the 157 minor loops may be defective, a control system must be used to condition data being exchanged with the bubble device. This means if 144 data bits need to be written on a page in the bubble device, 13 spacer or filler-type bubbles must be inserted where the defective loops are located. This is called redundancy, and one of the recommended approaches is to store the map of defective loops in a PROM. Each bit of data would then be gated with the contents of the PROM, thus preventing data from the defective minor loops reaching our data buffers. It is obvious that a relatively "smart" external device will be needed to exchange data with the bubble chip. There has already been a chip made to handle this problem. Texas Instruments' TM-9916 allows interface with 8080 processors, and more can be expected as the field of MBM continues to expand.

Write Sequence

Data is introduced into the major loop of the magnetic bubble memory via a generate current loop. The TIB-100 series uses a hairpin-shaped conductor loop called a nucleate generator. When energized by a current pulse it produces a bubble inside the hairpin loop. The creation of a bubble will constitute a logic one, and conversely, the absence of a bubble during a period will be defined as a logic zero. The major loop is essentially a unidirectional circular shift register with parallel transfer capability to the top bit position of the 157 minor loops. Thus, a data block of 157 bits would be entered and shifted until the first data bit is aligned with the most remote minor loop. At that time, the parallel transfer element would receive a current pulse, which sets up localized magnetic forces on the bubble domains to effect the parallel transfer of all the bubbles in the major loop to the top bit position of the corresponding minor loop. Since the MBM employs a redundancy scheme, the input data must be expanded by inserting logic *zero* between each input data bit to take into account the fact that there is a data position created in the major loop between each minor loop due to the physical geometry of the chip. Once data is written into the MBM, new data may be written only by first removing the old data by doing a destructive read.

Read Sequence

Detection of the bubbles is required to read the memory content. In a special section the bubbles' domains are stretched to approximately 400 times their normal diameter and passed over a permalloy magnetoresistive element. This causes a distinct change in the magnetoresistance of the permalloy. The stretching is the equivalent to preamplification and creates a sense signal of several millivolts. Bubble annihilation clears the memory data and is commonly combined with a replicator. Replication of bubbles allows a nondestructive read operation by duplicating information; one copy is read and discarded, while the original data remains in memory.

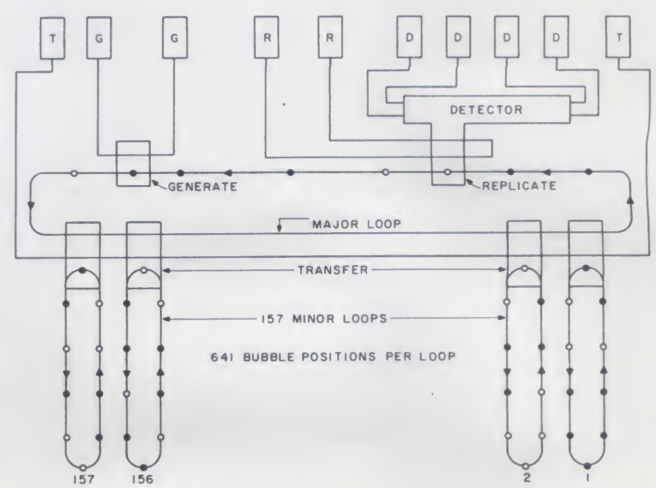

Fig. 2. Magnetic bubble memory 100K-bit bubble chip schematic. The polarity of the transfer pulse at the T inputs determines if the operation transfers data to or from the minor loops.

The data in the minor loops must first be rotated to place the block of data desired at the top bit (transfer) position in the loop. At this time the transfer element is activated as it was during the write operation, except with different timing. As a result, the bubbles will be removed from the top data position of each minor loop and placed in the major loop. The bubbles are then shifted to the replicator section of the major loop. If a destructive read is desired, a field is set up prior to the arrival of the bubble by passing a current through the replicate current loop at the proper time to deflect the bubble into the detector track. If it is necessary to restore the data in the minor loops, the current amplitude and timing are adjusted to serially replicate the data in the major loop. The data in the detector track will pass across two identical detectors before it is annihilated in a guard rail. The dual magnetoresistive detector scheme allows for differential sensing at the output of the MBM for improved common-mode noise rejection characteristics. The net loaded signal amplitude is in the neighborhood of 3 mV during the passage of the bubble in the detector region. The duplicate data remaining in the major loop is shifted until the first bit in the 157-bit block reaches the position above loop one. By this time the data in the minor loops have also made one full revolution; therefore, the data in the major loop is written into the minor loop by enabling the transfer element.

Control Considerations

The position of the minor loops is tracked with the use of an external counter. The first position in the minor loops to be written into will be designated as address zero. The external counter is cleared to count zero and incremented each time the data is shifted one position, i.e., one complete 360-degree magnetic field rotation. Prior to a power-down situation, the minor loops must be returned to a known position, usually a predetermined count value such as zero, so as to continue where it was when power was removed. Power supply integrity must be maintained during power down until the minor loops are correctly positioned. Since the bubble travel is undirectional, the worst case situation would happen when a transfer out operation from binary address 640 occurred at same time as the beginning of a power shutdown. For a nondestructive read operation, the data must make one full revolution in the major loop before it can be transferred back into the minor loops. Then the minor loops must also be rotated one full revolution to address zero before power supply regulation is lost. The total elapsed time in this situation is 12.8 μsec.

Summary

The magnetic bubble memories offer compact, high storage capacity, nonmechanical and nonvolatile data storage. The first commercially available MBM, as well as the first product using an MBM, was introduced in March of this year. As bubble technology increases and the cost per bit decreases, the MBM may soon replace existing electromechanical memories. The use of MBM by computer hobbyists and experimenters becomes more and more practical as the device cost continues to drop and the support electronics becomes available in IC form. By now, it is hoped, the magnetic bubble memory has ceased to be a nebulous entity; and, while you may not be ready to swap your floppy disk for one, at least you can deal effectively with the subject. ■

SCELBI's new '8080' STANDARD ASSEMBLER

FUNCTION: Assembles programs written in symbolic language for an 8080 CPU on an 8080 based system.

HARDWARE REQUIRED: 8080 computer with minimum of 4K memory (of which at least 1K should be RAM); a source listing input device; an object code output device.

OPTIONAL HARDWARE: A system console device such as a keyboard/CRT or keyboard/printer will allow convenient control of the program using executive commands; additional memory beyond 4K will allow expanded symbol table length, or capability to assemble directly into memory.

SOFTWARE REQUIRED: User provided I/O driver routines for whatever I/O devices will be utilized. Each I/O device is linked to the program by a *single* vector for ease in adapting the program to individual systems.

MEMORY UTILIZED: The assembled listing provided in the manual resides in pages 01 through 0A (hexadecimal — 001 through 012 octal). Pages 00, part of 0A, all of 0B and 0C (hexadecimal — 000, part of 012, 013 and 014 octal) are left available for user provided I/O routines. Pages 0D (hexadecimal — 015 octal) on up used for symbol table storage (or as direct assembly areas in systems with sufficient memory).

MNEMONICS UTILIZED: This program is written in, and accepts for assembly purposes, standard industry accepted mnemonics for the 8080 CPU (such as MOV A,B; INX H: CALL; etc.) [Note: SCELBI is discontinuing its use of special 8008 compatible mnemonics which have characterized its 8080 programs in the past.]

PSEUDO-OPERATORS: Accepts the ORG (originate), END (stop assembly), SET (define a name), DB (data byte), DS (data string) and DW (data word or double byte) pseudo-operators.

PROGRAM OPERATION: The program processes a source listing in two passes to produce assembled object code. An optional third pass allows an assembled listing to be obtained. Listings may be obtained in hexadecimal or octal format. The program will also display the contents of the symbol table at the operators request. The program can process source listings as single or multiple files. Program operation may be controlled from a console device using executive commands or through computer panel switches by jumping to appropriate locations within the program.

SOURCE FORMAT: Convenient, easy to use, variable length fields permitted. Labels may be 1 to 6 characters in length, accepts both hexadecimal and octal numbers with or without leading zeros, has "literal" capability (can accept ASCII characters directly as data), allows use of letters of numbers as CPU register operands.

DOCUMENTATION: Thorough — in the SCELBI tradition! The program manual describes the operation of the assembler, presents detailed discussions of all major routines, and contains two completely assembled listings (one provided in hexadecimal and one in octal notation). Of course it includes operating instructions and even provides a routine that may be used for loading programs produced by the assembler!

SPECIAL FEATURES: Because the program has been carefully organized and written with all memory references assigned labels, it may be readily reassembled to reside in any general area in memory. It may even be reassembled to reside in ROM provided that some RAM area is available for scratch pad and symbol table use!

OPTIONS: A punched paper tape of the object code for this assembler (as described in the documentation) is available. The object code tape is provided in the widely accepted "hexadecimal format." Also, the complete, commented source listing of the program as presented in the documentation is available in straight ASCII format on punched paper tape. Fan-fold paper tapes are provided for ease in handling. Additionally, opaque paper tape is supplied to facilitate the use of low cost optical paper tape readers now in widespread use. NOTE: Paper tapes are sold only as optional supplements to the documentation.

Scelbi's 8080 Standard Assembler: **$19.95** Optional object code on punched paper tape, specify 8080SA-OPT: **$10.00.** Optional commented source listing on punched paper tape, specify 8080SA-SPT: **$39.00.**

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Reliable Conversion Techniques

... try curve fitting for A/D accuracy

You've just finished connecting your A/D converter board to a whatzit transducer of your own design. You type RUN and your computer begins to record the amount of whatzit present at one second intervals. In an hour the computer has recorded 3600 separate measurements, each one of slightly different value. Some of the difference is probably due to measurement error (noise), but how can one filter out the error from the true data. One way is through the use of curve fitting.

The principle behind curve fitting is based on the assumption that the measured value Y_m is composed of the true functional value Y_t and a random error component E. If the error is truly random, then over many data samples the sum of the errors should tend toward zero. Thus, if we can find a curve in which the sum of the deviations of the measured values from the curve is at a minimum, that curve should be a close approximation to the true functional relation of the data.

This sounds simple enough; however, there are two big problems in finding the best curve for our data. First, we don't know what type of curve we are looking for (straight line, parabolic, etc.). Second, even if we knew the type, we don't know the parameters of the curve (2-unit focal point, 3-unit focal point, etc.). The first problem can be overcome quite simply — guess! In this respect, Mother Nature helps out. Quite a few measurable effects are linear. Even nonlinear effects can be reasonably approximated over a small enough region by a linear function. Thus the "least square straight line fit" is used extensively by researchers when analyzing data.

The equation for a straight line takes the form:

$$Y=A+B*X$$

A and B are the parameters that depend on the data (our second problem mentioned above). It is these parameters that we want the computer to find. Before going any further I should mention that we assume our data is equally spaced. For example, once every second we measure the whatzit level and record its value. The time would be recorded as the value of X, while the whatzit value measured for X would be recorded as the value of Y. We thus would have a record that would look like:

X	Y
1	2.1
2	3.3
3	4.8
4	5.0
5	7.9

Since the computer will be

A&B	Parameters of straight line
C-G,K1 & K2	Temporary variables
N	Number of data points
I	Used in FOR/NEXT loop
H(N)	Used to store data values

Table 1. Symbol list for straight line curve fit.

```
100 REM FOLLOWING ROUTINE ALLOWS TEST OF CURVE FIT SUBROUTINE
105 INPUT"NUMBER OF DATA POINTS" ;N
110 DIM H(N)
115 FOR I=1 TO N:PRINT"VALUE FOR DATA POINT";I;
120 INPUT H(I):NEXT I
125 GOSUB 1000
130 INPUT"VALUE FOR X";X
135 Y=A+B*X:PRINT"Y EQUALS";Y
140 GOTO 130
145 REM STRAIGHT LINE FIT SUBROUTINE FOLLOWS
1000 C=0:D=0:E=0:F=0
1005 FOR I=1 TO N:C=H(I)+C:D=I+D:E=I↑2+E
1010 F=H(I)*I+F:NEXT I
1015 G=D↑2:K1=C*E-D*F:K2=N*E-G
1020 A=K1/K2:K1=N*F-C*D:B=K1/K2:RETURN
```

Program A. Straight line curve fit.

$$Y = a_0 + a_1x + a_2x^2 + \ldots + a_nx^n$$

Example 1.

finding the curve for us, we need to put the data in a form that it can use. I have used a one-dimensional array (the array H(N)) in Program A. Using the above example:

H(1) = 2.1
H(2) = 3.3
etc.

The element H(0) is not used to store data.

The program has been written as a subroutine starting at line 1000. The subroutine will analyze the data and return the values for the parameters A and B, which will define the best straight line fit of the data. One word of caution! This routine is based on the *assumption* that there is a linear relation in the data. It does not prove that there is such a relation. Also, the program gives no estimation of the error in the data.

Now we have a program that will find the best straight line fit for our data. But there are enough measurable effects around that are not straight line (linear) functions. We really need a more general

called a polynomial in the indeterminate x of degree n. A polynomial of the first degree is nothing more than our old friend the straight line equation:

$$Y = a_0 + a_1x$$

A polynomial of the second degree will take the form:

$$Y = a_0 + a_1x + a_2x^2$$

and will be able to generate conic curves (parabola, hyperbola, etc.). The polynomials of the third and higher degrees will generate more and more complex curves.

Program B allows for a polynomial of the 16th degree to be specified. Well, why would anyone want a curve fit using a polynomial of such high degree? Let's say we have m points of data. Believe it or not, there is a set of parameters such that the curve described by the polynomial in Example 2 will pass *exactly* through every data point. In other words, the polynomial will exactly describe the measured effect.

$$Y = a_0 + a_1x^1 + a_2x^2 + \ldots + a_{m-1}x^{m-1}$$

Example 2.

program for the computer that would allow the option to choose what type of curve we try to fit to our data. Not to worry. There are a number of general curve fit algorithms around. One of the better ones is based on the Chebyshev polynomials.

I'm not going into the theory behind Chebyshev polynomials. However, one should understand the concept behind using polynomials to generate curves. A polynomial takes the form shown in Example 1 and is

Let's take the following example: We have five data points that we think fit a conic section, but we're not sure. We therefore set the degree of the polynomial to be found by our program to 4 (m=5 therefore m-1=4). We get the following parameters after we run the program:

a_0 = 3
a_1 = 2
a_2 = 1
a_3 = .006
a_4 = 1E-6

The coefficients a_3 and a_4 are small compared to the coefficients a_0 to a_2. We can therefore infer that the data fits a polynomial of degree 2 and that the residual seen in the 3rd and 4th power of x is probably due to noise in the data or the limits of precision of the calculations made by the computer. We can now rerun the program with the degree set to 2 and obtain a new set of values for a_0 to a_2. By lopping off the terms a_3x^3 and a_4x^4 we have filtered out a greater percentage of noise than data — i.e., improved the signal to noise ratio. (You'll have to take my word for this statement since an explanation would take an article as long as this one.)

Program B. Chebyshev curve fit (continued on next page).

```
50 REM THIS ROUTINE LOADS SOME TEST DATA IN H(N)
51 '
55 INPUT"NUMBER OF DATA POINTS";N
60 DIM H(N)
65 FOR I=1 TO N:PRINT"VALUE FOR DATA POINT";I;
70 INPUT H(I):NEXT I
94 '
95 REM THIS ROUTINE ALLOWS INPUTTING OF OTHER VALUES OF X
96 '
100 GOSUB1000
105 INPUT"VALUE FOR X";X
110 FOR K=1 TO M
115 I=K-1
120 Y=Y+Y(K)*X↑(K-1):NEXTK
125 PRINT "Y EQUALS";Y:Y=0:GOTO 105
130 '
135 '
900 REM CURVE FIT SUBROUTINE STARTS HERE
901 '
1000 PI=3.14159
1005 DIM R(25),V(100),Y(100),C(25),F(25)
1010 INPUT"DEGREE";M
1015 XM=1:DX=1
1020 REM COMPUTE MEAN OF DATA
1025 M=M+1
1030 FORI=1 TO M
1035 AR=(2*I-1)*PI/(2*M)
1040 MS=M+1-I:R(MS)=COS(AR)
1045 NEXTI
1050 REM NORMALIZE VECTORS
1055 DV=2/(N-1):V(1)=-1
1060 FOR I=1 TO N-1
1065 V(I+1)=V(I)+DV
1070 NEXTI
1075 FOR J=1 TO N:Y(J)=H(J):NEXTJ
1080 REM LANGRANGIAN INTERPOLATION
1085 I=1
1090 FOR L=1 TO N
1095 IF R(I) > V(L) THEN NEXTL
1100 U=(R(I)-V(L-1))/(V(L)-V(L-1))
1105 IFL > 2THEN1120
1110 F(I)=U*(Y(L)-Y(L-1))+Y(L-1)
1115 GOTO1135
1120 IF L >= N THEN 1110
1125 ZI=-U*(U-1)*(U-2)*Y(L-2)/6+(U*U-1)*(U-2)*Y(L-1)/2
1130 F(I)=ZI-(U+1)*(U-2)*U*Y(L)/2+U*(U*U-1)*Y(L+1)/6
1135 I=I+1
1140 IF M+1 <=I THEN 1160
1145 IF R(I) <=V(L) THEN 1100
1150 NEXTL
1155 REM COMPUTE COEFFICIENTS
1160 FOR I=1 TO M
1165 SU=0
1170 B=2+SGN(I-2)
1175 ON B GOTO 1180,1195,1210
1180 FOR J=1 TO M
1185 SU=SU+F(J):NEXTJ
1190 GOTO 1240
1195 FOR J=1 TO M
1200 SU=SU+R(J)*F(J):NEXTJ
1205 GOTO 1240
1210 V(1)=1
1215 FOR J=1 TO M
1220 V(2)=R(J)
1225 FOR K=3 TO I
1230 V(K)=2*R(J)*V(K-1)-V(K-2):NEXTK
1235 SU=SU+F(J)*V(I) :NEXTJ
1240 C(I)=2*SU/M
1245 NEXTI
1250 C(1)=C(1)/2
```

As I'm sure you have concluded, the Chebyshev curve fit program is both more complicated and more powerful than the simple straight line fit. It allows us to test various types of curves to determine which will best fit our data. Once we have made this determination we can interpolate and extrapolate the data. That means we can predict what the data might be sometime in the future. Our accuracy will be limited by whether the measured effect is nonrandom and whether the behavior of the effect during our data collection will continue into the future. Nevertheless, curve fitting is a way of finding a mathematical model that can predict a measured effect.

So, now you know how to give your computer a fit. ■

N	Number of data points
H(N)	Array for holding data
PI	3.14159
M	Degree of polynomial
XM	1 (starting value of X)
DX	1 (spacing of data)
I,J,L	Used in FOR/NEXT & Accumulators

Misc. Arrays Used:
R(25),V(100),Y(100),C(25),F(25)
Misc. Variables Used:
AR,B,DV,MS,NN,P,S1,S2,S3,SU,U,X,ZI

Table 2. Symbol list for Chebyshev curve fit.

```
1255 ZI=XM:NN=N-1
1260 FOR J=1 TO NN
1265 XM=XM+DX:NEXTJ
1270 S1=(XM+ZI)/2:S2=(XM-ZI)/2
1275 NN=M-1
1280 PRINT"POLYNOMIAL COEFFICIENTS-DEGREE":NN
1285 REM CHEBYSHEV SERIES CONVERTED TO POWER SERIES
1290 F(1)=C(1):F(2)=C(2)
1295 IF M <=2 THEN 1355
1300 FOR K=1 TO M
1305 V(K)=0:Y(K)=0:F(K+2)=0:NEXTK
1310 V(2)=1
1315 FOR K=3 TO M
1320 ZI=K-1:P=PI*ZI/2:Y(1)=COS(P)
1325 FOR J=2 TO K
1330 Y(J)=2*V(J-1)-Y(J):NEXTJ
1335 FOR J=1 TO K
1340 F(J)=F(J)+C(K)*Y(J):ZI=V(J):V(J)=Y(J):Y(J)=ZI:NEXTJ
1345 NEXTK
1350 REM DENORMALIZE TO ORIGINAL INTERVAL
1355 Y(1)=F(1)
1360 FOR K=2 TO M:Y(K)=0:NEXTK
1365 FOR K=2 TO M:L=K-1:Y(K)=Y(K)+F(K)/S2 ↑L
1370 S3=1:ZI=1
1375 FOR J=1 TO L
1380 S3=S3*J:DV=S3*S2↑L:ZI=ZI*(K-J)
1385 Y(K-J)=Y(K-J)+(ZI*S1↑J*(-1)↑J*F(K))/DV:NEXTJ
1390 NEXTK
1395 REM PRINT COEFFICIENTS Y(0) TO Y(DEGREE #)
1400 FOR K=1 TO M
1405 I=K-1
1410 PRINT"A(";I;")=";Y(K)
1415 NEXTK
1420 RETURN
OK
```

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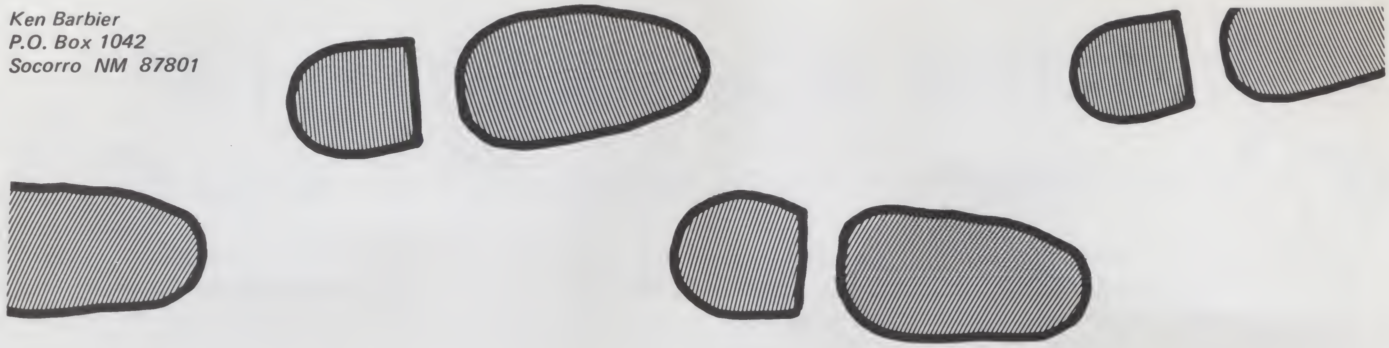


Salesmanship, Hardware and Coffee

... profit is the result!

I devoted an entire editorial (and some research) to the subject of this article in issue #6. Regardless, here it is again. The message isn't really intended for the average reader but more for the retailers and manufacturers in this industry. Note that I included the manufacturers in that last statement. Perhaps they should be making a greater effort to help retailers get their act together, and have turnkey systems that can be demonstrated doing home accounting, education, graphics, music and (most definitely) small business software. If we all work together in this field, we will all be successful. Think about it. If you're a manufacturer and your fantastic product is sitting out there in a store where people are saying such things as, "It will take three days to interface it," then you'd better get busy and do something to improve the situation. – John.

A friend of mine who owns a store that stocks lots and lots of low-cost items asked me if we could set up an automated inventory control and ordering system. His overworked wife was wearing her fingers down to little stumps filling out multi-lined order forms. This didn't leave her much energy for fixing dinner – hence the high priority accorded the project.

"No sweat," I blissfully replied. "A couple of kilobucks for off-the-shelf hardware and a couple of weekends of programming time and Betty can go back to the kitchen full time."

I volunteered to engineer a solution. Admittedly I was tantalized by the prospects of literally hundreds of stores that could use the same system, as they bought from the same suppliers. I assured Randy that the development of the microprocessor had ushered in the age of the affordable home/business computer at last. I had read all the ads, and weren't they just *full* of all kinds of goodies? So off I went, full of confidence, with a pocketful of cash and the addresses of twelve retail outlets in two of our largest cities. On my errand I visited no fewer than ten of these stores, whose locations I had gleaned from ads and store lists in the latest home/hobbyist computer magazines.

What follows is a factual account of my store trek. Names and locations are not mentioned out of sympathy for the well-meaning proprietors, and because by the time this is in print, specifics will have changed considerably. The general feeling that I came away with is that not one of the store operators is out to bilk the buyer or take advantage of anyone. They are not, however, adept at retailing. And that is an art in itself. But conditions will certainly be changing, and some of the stores I visited will not survive. As we go along together from one store to another, you will see what I mean.

Let us sally forth upon our steed of iron and see how a cash customer is treated in small computer stores. I'm sure that you will then agree with me that the millenium has not yet arrived.

Trek I

I entered the smoggy big city basin from the southeast, and, as luck would have it, the first store I encountered turned out to be the most well-stocked of all . . . generating all kinds of misconceptions. (Notice how cleverly I disguise locations.) I arrived at the address ten minutes before opening time, which, at 10 am is, I feel, a trifle late in the day. No matter, there was a sign on the door directing me to yet another address. As the new address was well within walking distance, I still arrived there before opening time. Waiting

impatiently at the door was a customer who told me excitedly that he was there to pick up his new (BEEP) computer system, and they had told him to be there at 9 am. As we waited, a young couple drove up. The male half drooled over the goodies displayed in the store window while his treasurer tried to hide her misgivings. Five minutes after opening time they gave up and left. Forever? I'd hardly blame them.

At nine minutes after opening time we were admitted to the sanctuary. Immediately the principal salesperson and his anxious customer started checking out the system to be delivered. This required considerable tutoring. Another early customer and I were ignored. As I browsed through an admittedly tempting display of new and used hardware, books and magazines, the Boss and Anxious continued their learning session. From the depths of the store the word came out that someone had brewed a pot of coffee. Boss went back and got a cup. Another Innocent walked in the front door. The other early browser walked out; 20 minutes after I had entered I walked out, having seen everything on display. No one had spoken a word to either of us quitters.

No one had said, "May I help you?" or "Would you like a cup of coffee?" Actually, I was *dying* for one. My thirst and cash were still with me when I left, totally unmolested, after 20 minutes of exposure to the "salespersons."

Now, only a masochist likes a pushy salesman. But selling is still selling. In a rapidly expanding market a salesman must realize that the person walking in the front door may need a lot of help. In any case, it should certainly be offered, to say the least. The reason I am harping on this point is that with two notable exceptions it applied equally to every computer store I visited. Technical expertise and enthusiasm may have been rampant in the stores, but salesmanship was totally absent in all but two.

The next address I had copied from a list of "Computer Stores" in another publication. It turned out to be a parts house only (the name of the store gave no clue as to what it sold). Here I was greeted with an obvious lack of enthusiasm, although not totally ignored. When I explained what I was after, I was at least directed to a nearby outlet which was too new to have made the list.

Number three was populated by a rather pretty typist who was spending her time entertaining a friend while hitting a key now and then. I started looking about and sure enough, in an unlighted alcove, I spotted a for-real computer — all alone, with its plug pulled out. I empathized. About this time the local beauty tore herself away from her tasks long enough to ask if she could help me.

"I don't know," I quickly replied, "what have you got here?" She only giggled and went back to her typing! Maybe she thought I was kidding? Two minutes later I had finished my circuit of the premises and walked out — cash still intact.

Store number four was the most intriguing of all: a modern office/store complex, an impressive sign, an empty store. Really empty. No counters, no shelves, nothing. A card on the door read, "By Appointment Only. Call --- ----." "Call?" I thought. "Why? What could the owner show me except the other side of the window?" How many miles had been driven by potential customers after reading the store's ad, only to be greeted by this? A mystery indeed. But I was looking for a computer, not a mystery.

A few miles up the freeway brought me to number five. Looking good! A fair stock of parts, kits, books, magazines. Even off-the-shelf software. Well documented, at reasonable prices, produced locally. Surely the tantalizing taste of things to come. I described my requirements to the friendly, helpful owner. He detailed the solution to the problem, offered software development at quite reasonable rates, and admitted that no printer was presently available to handle the output. In addition, he did not have a system available I could pay for, load into my car and take home — even though the cash was burning holes in my pocket.

In a not-too-prominent display area I spotted a new computer kit. The salesman explained that the stores themselves were producing it to fill the need for available hardware. He could not supply me with any data sheets, however, they weren't yet available. Neither was a working demonstrator — only a kit of parts. And no printer to go with it. A story I was to hear over and over.

Closer to the middle of the city was another outlet of the same name. Here were two actual real-live computers in operation. One was being demonstrated to a businessman on an errand similar to mine. The software being shown proudly was asserted to be a business accounting system; but any businessman could see that it was virtually useless as the entire data base had to be main-memory resident. The proprietor was anxious to please and as helpful as could be. He even helped the kid who was next to arrive to load and start up a Star Trek game. In so doing he interrupted a demonstration to two potential business users. I quickly diagnosed a failure in his priority interrupt structure.

In some things I am fanatical. All the time the demo was going on the proprietor was sipping a cup of coffee. He even took us into his back room to show us the "business" system he was developing. On our way we passed his coffee maker, a half a pot simmering. For all I

know it may still be there. We certainly weren't asked to join in.

Going to the number seven store in the big city was a totally wasted trip. An older store selling a completely different product line, it was nonetheless listed as an outlet for one of the major hobby computer manufacturers. Inside its dim showroom there was no sign of a microcomputer. Not even a sign of a microcomputer sign.

I never got my free cup of coffee that day. By this time it was late enough in the day for the afternoon beverage. I had a couple and pointed my steed down the old freeway toward home, my two kilobucks still secure in my jeans.

Trek II

Another day, another city, slightly south of the first. Here I had four addresses. Once again, the first visit was to the best-stocked store in the area — purely by chance.

Number one this day had two computers in operating condition on display, and another brand name sitting around looking pretty, but dead. I related my requirements to a clerk, who, I soon realized, was quite interested but totally unknowledgeable. When we got to the subject of printers he proudly pointed out that, sure enough, they had this here 40-column job ready to go. It was quite unlovely, appearing rather like an ancient telephone, and did not inspire confidence. I expected the first words it would print would be, "Dr. Watson, I need you. Come here." I asked for a demo. Calls were made to the back room and the brains of the outfit appeared. When I asked him to "Lemme see it run!" I was told, and I quote as accurately as my secretive note-taking will allow me, "We don't have any software to drive it, and besides it would take *three days* to hook it up." What a great sales pitch!

Southern location number two turned out to be of the same family of shops that had provided the best show in the smoggy city. Again, the boss man was helpful, friendly, and quite knowledgeable. Not only did he know his wares, but he had been in business in other fields for several decades and knew how to be helpful without being obnoxious. He admitted the virtual impossibility of keeping any operating systems available for demonstration. Too many customers with too much money were standing around in too-long lines. The manufacturers apparently did not want to supply assembled, tested systems, and even kits were hard to come by. Although he spent a great deal of time with me, and I would have liked to have bought a system from him, he could not supply me with what I was after: a complete system, including printer and mass storage. I did not even need software. How many thousands of businessmen out there are also waiting, pockets full of money?

The last address on my list was not as intriguing as the empty store had been. It was in a shopping center, and didn't exist at all!

Conclusion

An eager customer, with cash in hand and a trivial system requirement, spent two days in two large cities searching for the hardware that could solve his problem. He came away without spending any money — for there was no one around to *take* his money. Had he been a real novice when it came to computers or software, he would have had to have been *sold* a system. There was no one around to *sell* him a system. What do we need, before we can truly say that the age of the microcomputer has arrived?

First, we need *salesmanship*. I saw operating hardware in five stores, a dark system in a sixth. At no time was it suggested that I sit down at a keyboard and see what the magical boxes would do for me (I had pretended to be an inexperienced potential user, on all initial contacts). Now, imagine yourself in an automobile dealership. What is one of the first things a salesman will do? Sit you behind the wheel! Make you feel like you already own the car. Make you *want* to own it.

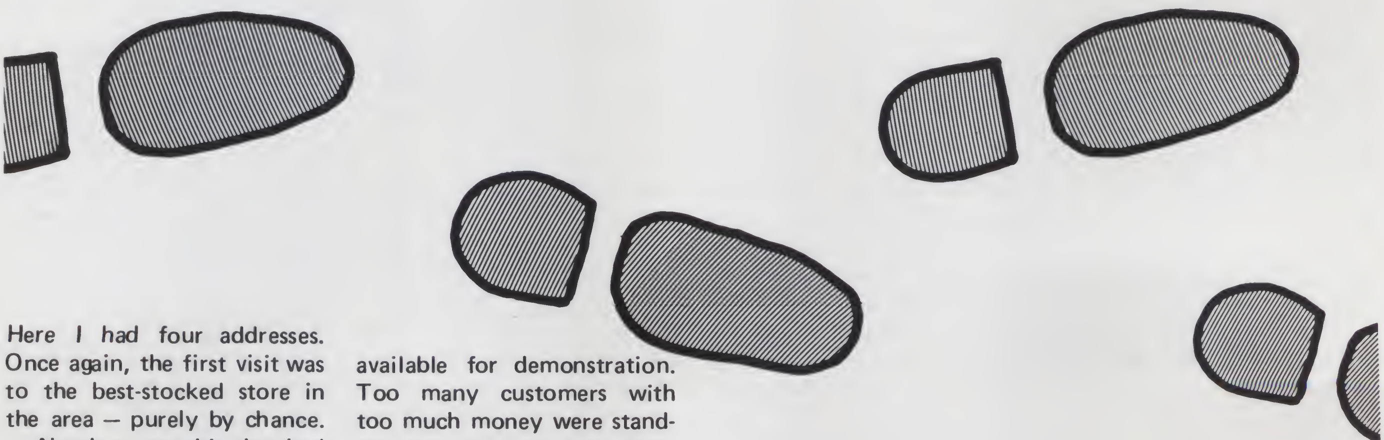
Offering a cup of coffee wouldn't hurt, either.

After salesmanship, we need hardware. For some reason, all but one of the operating computers I saw were from the same manufacturer. Maybe they try harder, because they aren't in first place. If supply can't keep up with demand, so be it. But the manufacturers had better be forewarned that the number of dedicated hobbyists willing to do their own assembly is numbered, and the first one on the market with a usable, turnkey system will get all the gravy. Does it need to be the people from across the sea, or the calculator manufacturers, who will corner the market? Are the real pioneers in this field doomed to extinction? It needn't be, but they had better get moving, and NOW.

Also, a real, live printer would have been a sight for smog-sore eyes!

Assembled and tested working hardware alone should find a ready market, as almost every high school and college graduate today has had some contact with programming. But the fertile field waiting to be sown is for a complete system with useful application software. Twelve kilobucks will buy it for you from the big boys, and you can bet that they are working diligently on reducing that by half. If the businesses that got their start by catering to dedicated hobbyists are going to get their share of this billion dollar market, now is the time to get things moving.

Surely profit margins would be great enough to permit offering a feller a cup of coffee now and then, too. ■



Hyper about Slow Load Times?

. . . KIM Hypertape is an alternative

Jim Butterfield
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Whenever I meet a bunch of KIM users in my travels, I'm likely to notice a couple of guys off to one side whispering and gesturing in my direction. This means either of two things: I'm wearing odd socks (again), or I'm being identified as the creator of KIM Hypertape.

Hypertape, often called super tape by KIM users, is indeed a good thing. It speeds up the standard KIM-1 cassette tape interface by a factor of six times. This gives a speed of roughly 50 bytes per second loading or dumping. It saves time and tape. And it's completely compatible with the KIM cassette tape loader — no extra hardware or software is needed to read Hypertape.

But I must confess: I didn't do it alone. I didn't even plan to write Hypertape; it sort of happened. It's not that I mind the fame. It's kind of nice getting fan letters and acknowledgements in other people's programs. And I have no objection to nubile nymphs strewing rose petals in my path, either, although I haven't had too many of those yet.

Now, it's time to own up. I wasn't a man with a vision struggling against innumerable setbacks. I fell into it on my way to something else. It's like the story of Thomas Edison picking up the world's first light bulb, admiring it, and then bringing it to his lips and hollering, "Hello? Hello?"

It all started last fall, when I was having lunch with Julien Dubé, a friend and fellow KIM owner, and Rick Simpson, then manager of KIM-1 Product Support for MOS Technology, Inc. Rick was talking about the cassette interface. "Maybe we should have made it faster," he mused. "It could be speeded up by a factor of three, but . . ." At that moment the chopped chicken livers arrived, and the sentence was never finished. But the phrase had caught my imagination. A speedup of three times! Wow! But how would it be done? To solve the mystery, I would have to look into the workings of the KIM cassette load/dump programs.

Recording Basics

The KIM User Manual describes the cassette recording principles quite clearly. The system uses frequency shift keying (FSK). The two tones used are at frequencies of 3700 Hertz and 2400 Hertz respectively. During a dump to cassette, the tones are generated directly from the microprocessor as square waves — no oscillators are involved. In reading back from cassette, the signal is fed to an LM565 phase lock loop used as frequency discriminator (see Fig. 1). Everything else is done in software — timing, assembling of characters, storage of data and checksum. Handy to know, but not enough.

The next step was to dig into the software. How are the bits represented on tape? Still not hard to find; KIM is well documented. The so-called 2/1 scheme is used: To record a logic zero, send 3700 Hertz for five milliseconds duration followed by 2400 Hz for 2.5 ms. To record a logic one, send 3700 Hz for 2.5 ms followed by 2400 Hz for 5 ms (see Fig. 2). Either way, it's about 7.5 ms per bit, right? And each sequence commences with the higher frequency.

Now we're getting somewhere. The next step is to look at the tape load monitor program and see how it gets those bits back off the tape. Aha! Here's what KIM does: It compares the timing of the two parts, 3700 Hz versus 2400 Hz. If the 3700 Hz signal lasts longer, the bit must be zero; if the 2400 Hz is the long one, then the bit is logic one.

Now, pay attention, we're almost there. If the KIM loader doesn't care about the actual timing, but just wants to know which frequency lasts longer . . . we can speed the whole thing up! As long as we keep the right timing ratio between the two frequencies, the KIM monitor won't worry whether it's fast or slow. Since we're dealing with input and output at the bit level, we don't need to

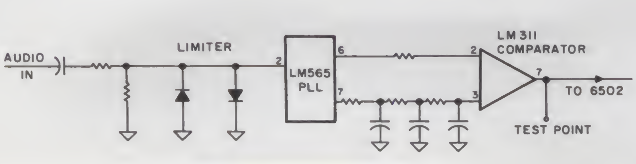

Fig. 1. KIM-1 audio tape input circuit.

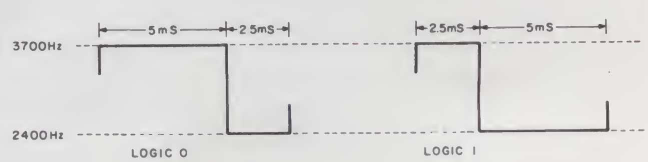

Fig. 2. Timing of normal KIM tape signals.

```
; OUTPUT 3700 HZ TO TAPE
; 9 PULSES 138 USEC EACH
;
ONE     LDX #9        N = 9 pulses
        PHA           Save A in stack
ONE1    BIT CLKRDI    Check timer
        BPL ONE1      Wait for timeout
        LDA #126      Next timing . .
        STA CLK1T      . . into timer
        LDA #$A7      Bit 7 on
        STA SBD        . . to output
ONE2    BIT CLKRDI    Wait for timeout
        BPL ONE2
        LDA #126      Next timing . .
        STA CLK1T      . . into timer
        LDA #$27      Bit 7 off
        STA SBD        . . to output
        DEX           one less cycle
        BNE ONE1      go back if more
        PLA           bring A back
        RTS           return from subroutine
```

```
; OUTPUT 2400 HZ TO TAPE
; 6 PULSES 207 USEC EACH
;
ZRO     LDX #6        N = 6 pulses
        PHA
ZRO1    BIT CLKRDI
        BPL ZRO1
        LDA #195
        STA CLK1T
        LDA #$A7
        STA SBD
ZRO2    BIT CLKRDI
        BPL ZRO2
        LDA #195
        STA CLK1T
        LDA #$27
        STA SBD
        DEX
        BNE ZRO1
        PLA
        RTS
```

Program A. Original KIM routines for sending the two frequencies to audio output. Note that the labels ONE and ZRO do not *indicate that we are sending logical one or zero from memory.*

```
; OUTPUT FREQ TO TAPE
; Y REGISTER SAYS WHICH FREQUENCY
;
ZON     LDX NPUL,Y    get N from table
        PHA           save A
ZON1    BIT CLKRDI    Check timer
        BPL ZON1      Wait for timeout
        LDA TIMG.Y    get timing from table
        STA CLK1T      . . into timer
        LDA #$A7      Bit 7 on
        STA SBD        . . to output
ZON2    BIT CLKRDI    Check timer
        BPL ZON2      Wait for timeout
        LDA TIMG,Y    timing from table
        STA CLK1T      . . into timer
        LDA #$27      Bit 7 off
        STA SBD        . . to output
        DEX           one less cycle
        BNE ZON1      go back if more
        PLA           bring A back
        RTS           return from subroutine
```

Program B. I've combined the two original KIM routines using the Y index register to indicate which frequency is involved. Note that I've done nothing new — just saved memory and punch-up time. But wait, ZON1 and ZON2 look very similar. Can I save even more?

```
; OUTPUT FREQ TO TAPE
; Y REGISTER SAYS WHICH FREQUENCY
; LOCATION GANG STARTS AT $27 HEX
;
ZON     LDX NPUL,Y    get half-pulses from table
        PHA           save A
ZON1    BIT CLKRDI    check timer
        BPL ZON1      wait for timeout
        LDA TIMG,Y    get timing from table
        STA CLK1T      . . put in timer
        LDA GANG      $27 or $A7
        EOR #$80      flip it over
        STA SBD       output it
        STA GANG      and save new GANG value
        DEX           one less half-cycle
        BNE ZON1      go back if more
        PLA           bring A back
        RTS           end of subroutine
```

Program C. Further consolidation of the coding. We're now counting half-cycles instead of cycles, and this turns out to be a big help.

worry about details of tape formats: special characters, checksums and items like that. They will all eventually be sent as bits — and it's the format of the bits we're dealing with. To telescope those bit signals, we must return to the audio dump program. So long as we write them properly onto tape, we know that the load program will track them correctly.

Counting Cycles

A little arithmetic, or failing that, a look at the KIM manual, shows that logic zero consists of 18 pulses at the higher frequency followed by six pulses at the lower. For logic one the numbers become nine and 12 (see Fig. 3). As I noted these numbers, the words kept echoing through my head, ". . . factor of three . . ." Suddenly the penny dropped. All the above pulses are multiples of three — so you can reduce the number of cycles to 2/3 or to 1/3 without getting into fractions. KIM sends all its cycles direct from software. So all you'd need to do is to change the loop counters and . . . hmmm, it might work. Of course, Rick's phrase was, ". . . factor of three, but . . ." But what? Would the phase lock loop be too sluggish to take the speed increase?

Did all these exciting discoveries send me rushing to the coding sheets to see if I could produce triple-speed tape? Nope. Next day, I was chatting to Julien Dubé again. "Funny thing," I said in my wise and knowing way. "I think there's a way to increase tape speed by at least 50 percent — it might even go up to triple speed." As usual, Julien made a good audience as I outlined my detective work of the previous evening. "What's more," I concluded triumphantly, "you'd hardly need to write it. Just copy out the ROM programs to RAM, change the pulse counters, and you have it!"

I thought no more of the conversation until late that evening when Julien called me. "Works fine," he reported. "Good at triple speed, too. Why did you suspect there might be a problem?" I found this disconcerting. Not only had Julien been listening to me earlier in the day, he'd gone right ahead and done it. I collected my thoughts.

"OK," I said, "The problem is that the phase lock loop is likely coming to the limit of its tracking capability. Put a meter on the output of the LM311 comparator. Normally it's 2.5 V, but at high speed it will start to pull because *of bias distortion.*"

Julien called back very quickly. "It's solid on 2.5 V

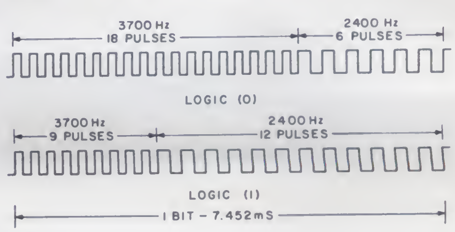

Fig. 3. KIM standard audio signals.

at the highest speed," he reported. "Loads without error, too. Funny thing — I've listened to the tape itself and it sounds totally different than ordinary KIM tape."

On to the Coding Sheets

I think it was that last comment that got me. How can it sound different when it's the same two frequencies? Besides, the phase lock loop behavior intrigued me: How could it track on only two cycles? How much further could it go? At this stage, triple speed, we were sending a minimum of only two pulses at one frequency and three at the other. Could I speed that up without getting into fractions? I couldn't see how. Can you send half a pulse? That sounds like the paradox of one hand clapping. I was unable to see it.

Let's pick over the original KIM monitor coding for sending the two frequencies. It's shown in Program A. Well written, but since we need to change it anyway, let's see what we can do with it. Subroutines ONE and ZERO are almost identical. They differ in only two items: nine cycles versus six cycles, and 126 microseconds of delay in the timer versus 195 microseconds. Automatic programming reflex number one: Consolidate them and put the two variables in a table.

Assuming we have that squared away (see Program B), there's another piece of duplicate coding: The sequences at ONE1 and ONE2 (and their counterparts in ZRO) are almost the same. This time, the difference is in hexadecimal 27 versus A7. These values are sent to the output register to make bit 7 (the tape output) go on and off, generating the square wave that we record on tape. Automatic programming reflex number two: when you have a bit going back and forth like that, use an EOR (Exclusive OR) instruction to flip it over and back.

That last part is more than just efficient coding; it has important consequences for us to follow through. Previously, we generated a square wave by having a piece of program to turn the bit on, followed by a piece of program to turn it off again. That makes one full cycle of the square wave. But if we go the EOR route (see Program C), we'll flip the bit over and generate one-half of the square wave. That's what we've been looking for: a way to generate half a pulse. We've opened the door to sixfold speedup.

Now all the pieces have come together, and the coding comes easily. We have the number of half-cycles for each frequency in a table, so we can easily adjust the program for other speeds. At maximum — Hypertape — speeds, we'll be sending as little as one pulse at the lower frequency and 1.5 pulses at the higher frequency (Fig. 4). Can the phase lock loop track it? You bet it can — and the 2.5 V test point stays steady as a rock.

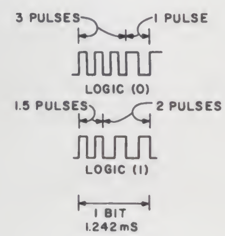

Fig. 4. Hypertape audio signals.

Wrapping It Up

The test runs were a bit eerie. Even when you do the arithmetic, it doesn't seem right for a 30-second program to load in five seconds. At first, it all happened so quickly that I was sure there was something wrong. But it checked out OK, and Hypertape became a reality.

Tests of various tape recorders revealed that a few of them won't carry Hypertape, apparently because their frequency response is too poor to carry the high sidebands of the signal. A related problem occurs in exchanging tapes from one cassette unit to another: Slight head misalignment causes those vital high frequencies to be lost. It's a good practice for KIM tape swappers to drop their speed to a paltry three times normal to eliminate this potential problem. Of course, the documented and tidied up program (Program D) was

Program D. The final, polished, complete version for reading and writing data in the Hypertape format.

```
                ;hypertape writer starts here
0100 A9 AD      DUMP     LDA #$AD      LDA command
0102 8D EC 17            STA VEB
0105 20 32 19            JSR INTVEB    set up sub
0108 A9 27               LDA #$27
010A 85 F5               STA GANG      flop flag for SBD
010C A9 BF               LDA #$BF
010E 8D 43 17            STA PBDD      directnl registr
0111 A2 64               LDX #$64      send 100 . .
0113 A9 16               LDA #$16      . . SYNC chars
0115 20 61 01            JSR HIC
0118 A9 2A               LDA #$2A      send START (*)
011A 20 88 01            JSR OUTCHT
011D AD F9 17            LDA ID        send pgm ID
0120 20 70 01            JSR OUTBT
0123 AD F5 A7            LDA SAL       & start addrs
0126 20 6D 01            JSR OUTBTC
0129 AD F6 17            LDA SAH
012C 20 6D 01            JSR OUTBTC
012F 20 EC 17   DUMPT4   JSR VEB
0132 20 6D 01            JSR OUTBTC    send byte . .
0135 20 EA 19            JSR INCVEB    move to next . .
0138 AD ED 17            LDA VEB+1
013B CD F7 17            CMP EAL       is it last byte?
013E AD EE 17            LDA VEB+2
0141 ED F8 17            SBC EAH
0144 90 E9               BCC DUMPT4    no, repeat
0146 A9 2F               LDA #$2F      yes, send . .
0148 20 88 01            JSR OUTCHT    . . END (/)
014B AD E7 17            LDA CHKL
014E 20 70 01            JSR OUTBT
0151 AD E8 17            LDA CHKH      checksum
0154 20 70 01   EXIT     JSR OUTBT
0157 A2 02               LDX #$02      send two . .
0159 A9 04               LDA #$04      EOT characters
015B 20 61 01            JSR HIC
015E 4C 5C 18            JMP DISPZ     & we're done

                ;subroutines
0161 86 F1      HIC      STX TIC
0163 48         HIC1     PHA
0164 20 88 01            JSR OUTCHT    send character
0167 68                  PLA           . . bring it back
0168 C6 F1               DEC TIC
016A D0 F7               BNE HIC1      repeat as needed
016C 60                  RTS
016D 20 4C 19   OUTBTC   JSR CHKT      compute checksum
0170 48         OUTBT    PHA           save the character
0171 4A                  LSR A
0172 4A                  LSR A         . . and take its
```

fired off to the KIM User Notes for more extensive field testing. Acknowledgement was given to Julien Dubé for his help.

As you can see, Hypertape's speed came from putting the bits more compactly onto tape. There are still other areas where the signal can be made more efficient. For example, each byte of storage is translated into two hexadecimal characters. That's a waste of two-to-one, since 16 bits are used to store eight. Then there's the question of the 2/1 coding scheme; that uses three bit-times to store each bit. And of course, we haven't touched on the question of data compression. There are still worlds to conquer. But I think I'll take it easy for a while. After all, there's something to be said for full compatibility with the KIM monitor. Then again, if Julien isn't doing anything next month . . . . ■

```
0173 4A                     LSR A           four left bits . .
0174 4A                     LSR A
0175 20 7D 01               JSR HEXOUT      write 'em
0178 68                     PLA             now the 4 right bits
0179 20 7D 01               JSR HEXOUT
017C 60                     RTS
                  ;
017D 29 0F        HEXOUT    AND #$0F        remove unwanted bits
017F C9 0A                  CMP #$0A        convert to ASCII
0181 18                     CLC             . . by adding:
0182 30 02                  BMI HEX1
0184 69 07                  ADC #$07        $37 if A to F;
0186 69 30        HEX1      ADC #$30        $30 if numeric.
0188 A0 07        OUTCHT    LDY #$07        For the 8 bits:
018A 84 F2                  STY COUNT
018C A0 02        TRY       LDY #$02        send 3 units
018E 84 F3                  STY TRIB        starting at 3700 Hz
0190 BE BE 01     ZON       LDX NPUL,Y      # of half cycles
0193 48                     PHA
0194 2C 47 17     ZON1      BIT CLKRDI      Wait for previous . .
0197 10 FB                  BPL ZON1        cycle to complete
0199 B9 BF 01               LDA TIMG,Y      Get timing to the . .
019C 8D 44 17               STA CLK1T       next pulse (7E or C3)
019F A5 F5                  LDA GANG
01A1 49 80                  EOR #$80        Flip between 1 & 0
01A3 8D 42 17               STA SBD
01A6 85 F5                  STA GANG
01A8 CA                     DEX             Sent all cycles?
01A9 D0 E9                  BNE ZON1        no, go back
01AB 68                     PLA             yes, recall char
01AC C6 F3                  DEC TRIB        one less to send
01AE F0 05                  BEQ SETZ        branch if last one
01B0 30 07                  BMI ROUT        branch if no more
01B2 4A                     LSR A           Take next bit
01B3 90 DB                  BCC ZON         . . if it's a one . .
01B5 A0 00        SETZ      LDY #0          Switch to 2400 Hz
01B7 F0 D7                  BEQ ZON         unconditional return
01B9 C6 F2        ROUT      DEC COUNT       one less bit
01BB 10 CF                  BPL TRY         any more? go back
01BD 60                     RTS
                  ;frequency/density controls
01BE 02           NPUL      .BYTE $02       Two pulses! One cycle!
01BF C3 03 7E     TIMG      .BYTE $C3,$03,$7E
```

Interested in Commercial Programming?

. . . some points to consider

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Suddenly, after all the games and home application programs, you realize that maybe it's time to go commercial (i.e., write programs to sell). You create a catchy name for your company, have business cards printed, and maybe place an ad in *Kilobaud* magazine. And now you are ready to write commercial software, right? Well, maybe!

Unless you are an unusual hobbyist, the transition from writing personal programs to writing commercial programs is not quite that simple. You will need to give a great deal of attention to areas that you have probably considered only briefly – if at all.

Before you begin you must decide if you will be writing programs for other hobbyists or if you are aiming at business applications. The

essential difference is that another hobbyist will have a fairly good understanding of what the computer is doing and can work around certain shortcomings. He will probably even modify your program to satisfy his own needs. The commercial user, on the other hand, knows his job and what he expects the computer to do for him; but he will probably have little or no understanding of how computers work. He will be impatient with sketchy documentation or programs written with no attention to human engineering. Anyone purchasing your system has a right to expect good system documentation and good human engineering.

These terms sound wonderful, like motherhood and apple pie, but just what do they mean in practical terms? The remainder of this article will attempt to impart some understanding of what each of these areas entails. Volumes have been written on documentation and human engineering, so the treatment here will in no way be exhaustive. My intent is to give you a feel for the kinds of things to consider in each of these areas.

Documentation

The first encounter that a user has with your system is probably through the documentation. His reaction to it may well determine his confidence, or lack of it, in your system. Just as you would shine your shoes before a job interview you must polish your documentation before attempting to sell your system. There is no single correct way to write documentation; it is merely important that it include the necessary ingredients, well presented.

First, tell the user what problem your system attempts to solve and what it will do for him. This overview will probably have the greatest influence on a prospective client, and may determine whether or not he is willing to buy your system.

```
AFTER THE QUESTION MARK "?" ENTER THE EMPLOYEE'S NAME AND
SOCIAL SECURITY NUMBER SEPARATED BY A COMMA "," AS FOLLOWS:
?JOHN DOAKES,111-22-3333 ?
```

Example 1.

If your overview can show him that you have a good understanding of his problems, he will have confidence in your ability to solve them. If you have told the user precisely what the system can (and cannot) do, he will have no illusions about its capabilities.

Second, indicate how you plan to solve the problem. Tell the user what information he must supply to the programs, how this data will be used and manipulated and, finally, what he will be given in return. Include sample inputs and outputs so he will not be surprised the first time he runs the program. The slogan of a famous motel chain is equally applicable here: "The best surprise is no surprise."

Error Messages

Provide a list of all error messages that your program might print, and explain in as much detail as you can what each message means. Indicate all known cases where an error condition might generate other error messages. Describe how to clear all probable causes for each error condition. Regardless of how well your documentation is written, the user is bound to make errors, so try to make them as painless as possible. Do not skimp on words and don't be afraid of redundancy. When a user is trying to determine the reason for an error message, there is nothing more frustrating than his having to search for information.

List all resources required to run your system. Indicate how much memory is needed, how much and what kind of storage (such as disk) is required, and what language and level of compiler (or translator) is necessary. In addition to specifying minimum requirements, indicate how run efficiency might be improved by increasing certain resources above the minimum. For example, one disk drive may be required to run your system, but greater efficiency might be achieved with two or three.

Finally, give the user some helpful hints on how to improve operations once he has become more familiar with the system. If possible, suggest alternate uses for it. If you establish a feedback channel you will find that imaginative users will discover operating procedures and new applications for your system that you never dreamed of.

Human Engineering

Human engineering is not an exact science but rather an application of good common sense. Using human engineering in program design means trying to anticipate the areas that could be difficult or confusing for the user and attempting to eliminate or explain them. Remember, the only purpose for your system

```
10 PRINT"HAVE YOU USED THIS PROGRAM BEFORE";
20 INPUT A$
30 IF LEFT$(A$,1)="Y" GOTO 80
40 PRINT"ENTER EMPLOYEE'S NAME AND SOCIAL SECURITY"
50 PRINT"NUMBER AS FOLLOWS:"
60 PRINT"JOHN DOAKES,111-22-3333"
70 PRINT
80 PRINT"NAME,SS#";
90 INPUT N$,S$
              /
              /
              /
              /
500 GOTO 80
OK

RUN
HAVE YOU USED THIS PROGRAM BEFORE? N
ENTER EMPLOYEE'S NAME AND SOCIAL SECURITY
NUMBER AS FOLLOWS:
JOHN DOAKES,111-22-3333

NAME,SS#? JOHN DOAKES,111-22-3333
NAME,SS#? . . . . . ETC.

RUN
HAVE YOU USED THIS PROGRAM BEFORE? Y
NAME,SS#? JOHN DOAKES,111-22-3333
NAME,SS#? . . . . . ETC.
```

Fig. 1. The detailed prompt followed by the abbreviated prompt.

(aside from making money) is to help the user.

Your program cannot work properly if the user does not input the correct data, so don't be cryptic with your prompts. If the program requires that he enter a certain type of information, tell him what is required. For example:

N,S?

probably would not mean anything to the user and would undoubtedly confuse him. He might be forced to guess what is required and would probably guess wrong. On the other hand:

NAME,SS#?

would probably be understood as a request for a name and Social Security number. Be careful, though. If a little dialogue is good, a lot is not necessarily better. Consider the prompt in Example 1. If the user has no experience with interactive programs, this message might prove useful — once. But if 100 employees must be entered, and each is prompted by this message, the user will soon grow weary.

One way to overcome this is to give a detailed prompt once and an abbreviated version thereafter. As the user gains experience with the system, even the detailed prompts become unnecessary. Fig. 1 is an example of this method. The user is given a detailed message once, and from then on it is assumed he knows what is required.

For other applications the input requirements are more complicated; the learning curve approach might prove more practical. In this method the transition from detailed to abbreviated prompt is gradual rather than immediate. In Fig. 2 the user is given several levels of prompts, depending upon his familiarity with the system.

```
10 PRINT"HOW FAMILIAR ARE YOU WITH THE PROGRAM?"
20 PRINT"0 = UNFAMILIAR"
30 PRINT"1 = SLIGHTLY FAMILIAR"
40 PRINT"2 = VERY FAMILIAR"
50 INPUT A
60 IF A <>INT(A) GOTO 80
70 IF A >=0 GOTO 100
80 PRINT"ANSWER ONLY 0, 1 OR 2";
90 GOTO 50
100 IF A >2 GOTO 80
110 X=5*A
120 ON A GOTO 170,190
130 PRINT"ENTER EMPLOYEE'S NAME AND SOCIAL"
140 PRINT"SECURITY NUMBER AS FOLLOWS:"
150 PRINT"JOHN DOAKES,111-22-3333"
160 PRINT
170 PRINT"EMPLOYEE'S NAME,SOCIAL SECURITY NUMBER";
180 GOTO 200
190 PRINT"EMP NAME,SOC SEC #";
200 X=X+1
210 GOTO 230
220 PRINT"NAME,SS#";
230 INPUT N$,S$
          /
          /
          /
          /
500 IF X >10 GOTO 220
510 IF X >5 GOTO 190
520 GOTO 170
OK

RUN
HOW FAMILIAR ARE YOU WITH THE PROGRAM?
0 = UNFAMILIAR
1 = SLIGHTLY FAMILIAR
2 = VERY FAMILIAR
? 0
ENTER EMPLOYEE'S NAME AND SOCIAL
SECURITY NUMBER AS FOLLOWS:
JOHN DOAKES,111-22-3333

EMPLOYEE'S NAME,SOCIAL SECURITY NUMBER? JOHN DOAKES,111-22-3333
EMPLOYEE'S NAME,SOCIAL SECURITY NUMBER? . . . . . ETC.

RUN
HOW FAMILIAR ARE YOU WITH THE PROGRAM?
0 = UNFAMILIAR
1 = SLIGHTLY FAMILIAR
2 = VERY FAMILIAR
? 1
EMPLOYEE'S NAME,SOCIAL SECURITY NUMER? JOHN DOAKES,111-22-3333
EMP NAME,SOC SEC #? . . . . . ETC.

RUN
HOW FAMILIAR ARE YOU WITH THE PROGRAM?
0 = UNFAMILIAR
1 = SLIGHTLY FAMILIAR
2 = VERY FAMILIAR
? 2
EMP NAME,SOC SEC #? JOHN DOAKES,111-22-3333
NAME,SS#? . . . . . ETC.
```

Fig. 2. Different levels of prompts.

Another important human engineering concept is defensive programming. Essentially, this means trying to anticipate all possible types of errors that the user could make and taking steps to protect the program against them.

Suppose that you have written an inventory system, and a salesman accesses it to enter his sales. He must enter an item number (a number from 1 to 100) and the quantity sold. In Fig. 3 there was no defensive programming to protect against the salesman's error, so the resultant messages probably confused him and resulted in much lost time. The defensive programming technique used in Fig. 4 protects against this problem. In this way the program will not terminate abnormally, and the user's efforts up to that point will not be lost.

Input/Output

There will usually be several possible ways of accepting input data from the user. Some will be simpler for the programmer, while others will be simpler for the user. Unless there are other overriding reasons for selecting one method over another, always opt for the method which will seem easiest and most natural for the user.

Suppose that there is an employee file on disk that the program must read and update. The user is to input the hours that each employee worked that week. It would

```
10 DIM S(100)
          /
          /
          /
          /
100 PRINT"ITEM NO.,QUAN";
110 INPUT I,Q
120 S(I)=S(I)+Q
          /
          /
          /
          /
400 GOTO 100
OK

RUN
ITEM NO.,QUAN? 20,15
ITEM NO.,QUAN? 45,23
ITEM NO.,QUAN? 102,30
SUBSCRIPT OUT OF RANGE IN 120
OK
```

Fig. 3. A confusion factor — to be avoided.

```
10 DIM S(100)
          /
          /
          /
          /
100 PRINT"ITEM NO.,QUAN";
110 INPUT I,Q
120 IF I=INT(I) GOTO 160
130 PRINT"ITEM NO. MUST BE AN INTEGER FROM 1 TO 100"
140 PRINT"PLEASE RE-ENTER ";
150 GOTO 100
160 IF I<1 GOTO 130
170 IF I>100 GOTO 130
180 IF Q=INT(Q) GOTO 210
190 PRINT"QUANTITY MUST BE AN INTEGER"
200 GOTO 140
210       /
          /
          /
          /
400 GOTO 100
OK

RUN
ITEM NO.,QUAN? 20,15
ITEM NO.,QUAN? 45,23
ITEM NO.,QUAN? 102,30
ITEM NO. MUST BE AN INTEGER FROM 1 TO 100
PLEASE RE-ENTER ITEM NO.,QUAN? 100,30
ITEM NO.,QUAN? 47,.56
QUANTITY MUST BE AN INTEGER
PLEASE RE-ENTER ITEM NO.,QUAN? 47,56
ITEM NO.,QUAN? . . . . . ETC.
```

Fig. 4. Human engineering — to help the humans.

be simple for the programmer to read each employee's name from the file and ask for his hours. This method would be fine if the user were working from a document listing employees in the same order that they occur in the file; but he may be working from time cards arranged in random order. It would be easier for him to input the employee's name and hours in the order in which the cards occurred and let the program sort them into the required order.

Most business applications will require one or more reports to be produced. A report may show total hours worked on each of several projects, together with associated costs; or you may have to produce a list of all inventory items which have dropped to the reorder point, together with reorder quantities. Whatever the report, the emphasis should be on usability. The user *should* not be left with the feeling that a degree in report reading is required.

As much as possible, the report should be self-explanatory. It should have a meaningful title which appears at the top of every page; the pages should be numbered and dated; column headings should be descriptive and clear. Avoid abbreviations unless they are necessary, in which case they should be explained.

Format data for easy readability by the use of spacing and blank lines. Columns should be spaced far enough apart to show that they are separate but not too far apart. Insert blank lines to improve readability. The human mind can usually discern three items simultaneously so a blank line should be inserted after each three (five at the most) lines of data. Consider the report format depicted in Figs. 5a, 5b and 5c to determine which is most readable.

Conclusion

Putting together a good commercial package requires a great deal of role playing and common sense. Try to put yourself in the position of the user, and try to remove yourself from the role of programmer.

It is a natural tendency among humans (a category that includes many programmers) to defend their creations, but this tendency must be resisted if you are to produce acceptable systems. Use your ingenuity to devise ways to make the system fail. When reading your documentation, try to forget that you wrote it and pretend it was written by your worst enemy.

If your system is able to withstand such a savage onslaught it is probably as good as you would like to believe it is. ■

STOCK NO.	PRICE	DESCRIPTION
582974309	$506.54	HZOHPVCORDZ
999041369	$411.73	ODTDDKJVSTA
711778039	$472.88	FWQARSVRAFC
044319149	$660.78	DVNJONHSHLX
344664861	$692.81	DBSYFTKJFEF
991451211	$229.21	OGDILIUAVFX
277379649	$708.52	VJFOOKUNKYV
604002039	$657.17	AKGCXGQXATN
820036226	$385.89	JVXOXCSALIR
571520654	$614.20	HTGDVRWRTIX
063184841	$392.11	BTQIDTOMBKR
490238422	$216.11	AIOPMYYPECD
183525243	$730.47	VYGBJVIWNFN
325924388	$106.51	QCCVCWAFPOY
279126857	$297.66	TMCWAVYODDF
534936327	$838.20	NNHRTPBIDXM
492869710	$907.30	GQLUOFTJLJK
643135784	$848.74	DURSLSQHDFU
341410743	$186.43	GKNHFIBLSRO
913535610	$376.70	MUEUQOXPDXC
510011322	$117.99	NIVFLRJKYOB
109162566	$130.41	BWLRYWSQOYM
134009579	$342.49	SSAMBXBHKUY
414254160	$611.76	KDYAOUPZEWF
795863838	$281.33	AETDRCBALZI
884953242	$617.33	DIYGBLDMNFW
017680766	$305.71	LGDAJNZMLYE
570837179	$532.73	HJAJPSJWIJO
942674755	$822.25	WMZKBFVUBDW
185832248	$349.54	CPSBDXTQDKL

(a)

STOCK NO.	PRICE	DESCRIPTION
534610485	$673.56	VCCXNOAPAIL
037233688	$903.26	PUEPRHQQEWQ
747595353	$090.45	NAMBXUNWAYJ
443449898	$168.89	HVNYVHEYBBC
773950634	$589.47	QVZUQTILRNQ
815179128	$138.01	ZXBHCPXBEBW
946472906	$593.76	ETAQGYCOROS
370587085	$236.37	KLAVTSSBKOG
777741322	$739.53	IGKYAJNCAEE
430114283	$047.24	VPOQDMUXURP
641175210	$427.96	LNVWHYHYAXA
004991452	$232.81	AKXXPCHSHWB
763941054	$088.57	JWPTYMPWIZR
354915641	$559.54	WNLOSHWPZNF
146204108	$357.10	LUSSEYYRWSK
608204091	$023.39	YGNQXUXRWKO
392120967	$607.61	WGCREZLPWFB
438433967	$122.57	VCVOKROLBWL
343257557	$764.49	TAODOYWPVWQ
977063441	$771.39	OQOFWMGMPLP
281839490	$834.63	IPHFSRXJSLI
236694901	$825.95	QLVDGIEQPJP
033487274	$096.56	ZQEKCHYRBJF
165109955	$502.03	CCAYUDYBFIO
888241291	$165.32	GQQYVABSRGP
788424099	$780.49	ZJSNIHXJVUW
049559474	$607.57	XNFIORPURYH
710440681	$124.21	JXBPLKBSQVO
688751403	$595.44	JUEJAYMYGQC
221361409	$332.49	LREVSGMJDTY

(b)

STOCK NO.	PRICE	DESCRIPTION
306643212	$677.67	RLNADIDSMLJ
954544008	$379.18	GFYOWNKKNZO
207495490	$691.05	EXWJJJNOPBT
406535541	$697.19	FPPLMDKMZFQ
503435720	$730.15	SLAFXDRIHLN
685274321	$166.63	JBFWQHQMFID
715977340	$426.06	ZAIZICOPASY
859053631	$986.84	OVKJKXVNOPE
787957464	$343.35	YEUGNJVTROH
823024759	$932.53	YAWSXRGMOJY
052601146	$701.44	PJPRKDDMWCN
921553273	$335.83	CZFOALFVXMF
499856777	$409.39	YFMRLNFBHIR
245345993	$746.65	ROAKWCZSNJA
309090792	$776.10	GNUKJOBEJIR
633582969	$129.68	HDRBXMJADHO
659003072	$127.14	KABPPNAKMSY
893685986	$544.42	RFJDZHYQHTW
788936694	$754.04	AFBPSCEOWYU
794563761	$400.64	EXITNSRFIEM
847467331	$558.90	NNIEPDKJBFQ
396498435	$325.52	WEOISNCCPEP
195870198	$965.63	OIVHSUTILBK
509179869	$124.39	WRWIACTUSVS
206413047	$782.32	ZDKPFANNIWL
013317016	$150.23	JFVEWWXFKJZ
030725705	$715.22	ZMBMRWKRUMG
937702944	$806.02	XCRZWOJZILV
289230731	$103.84	EYMMESSPIUY
443744372	$525.09	BKGNDBGFZSO

(c)

Fig. 5. Formatting examples. You pick the best one.

The Small Computer

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P3

KILOBAUD KLASSROOM NO. 6

. . . voltage, current and power supplies

George Young
Sierra High School
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In class session 5 we looked at the other members of the NAND gate family and studied the four different logic functions: NAND, AND, OR and NOR. Now we're going to study microprocessor power supplies. After the unregulated power supply section was completed, it was found to be entirely too long to include here, so plans are to print the article in our sister publication, *73 Magazine*. In this session we will take up additional material on voltage regulation and overvoltage protection; and, for fun, we'll include a touch control circuit.

Power Supply Characteristics

For TTL integrated circuits, a power supply of 5 volts plus or minus ¼ volt is recommended. TTL chips are guaranteed by the manufacturer to operate satisfactorily only within this narrow voltage range. The maximum supply voltage is usually given as about 7 volts. This means that if more than 7 volts are applied to the chip it is likely to be permanently damaged.

Fig. 1 shows again the unregulated power supply used in the Kilobaud Klassroom console. With no load connected (no power being drawn from the power supply) the output voltage will measure about 10 volts on a dc voltmeter. Each diode is being fed ½ of the 12.6 V ac transformer secondary voltage, or about 6.3 volts ac. As mentioned in earlier Klassroom sessions, the filter capacitor will charge up to 1.41 times the ac RMS (Root Mean Square) voltage. This should give 6.3 x 1.41 or about 8.83 volts dc out of the filter capacitor. So why do we measure 10 volts out of this power supply?

A small transformer is not as efficient as a larger one that has more iron in it. To compensate for this inefficiency, the transformer manufacturer adds a few extra turns to the transformer secondary so that it will deliver its rated secondary voltage at the full current load. This means that the particular transformer that we used here actually has more than 12.6 volts ac out of the secondary when no current is being drawn from the power supply. Because the secondary voltage is higher, the capacitor charges up to 1.41 times whatever this secondary voltage *actually* turns out to be, and therefore we measure 10 volts dc, or a little more, across the filter capacitor with no load

connected.

As the load on the power supply increases (as more current is drawn from the power supply by the circuits connected to it) this 10 volts dc will sag lower and lower, until at the full current rating of the transformer, the output dc will approach the input ac voltage of 6.3 volts. If more iron is added to a power transformer, the efficiency of the transformer increases. With a 12.6 volt center-tapped secondary and a 3 ampere current rating it will have much better voltage regulation than the transformer used in Fig. 1.

Power supply voltage regulation refers to the change in the output voltage of a power supply with no current being delivered to the load compared to the output voltage at the full current load. Because this voltage changes from 8-10 volts down to 6-8 volts, and our TTL chips require 5 volts, we must have some additional voltage regulation circuitry in order for our TTL circuits to operate.

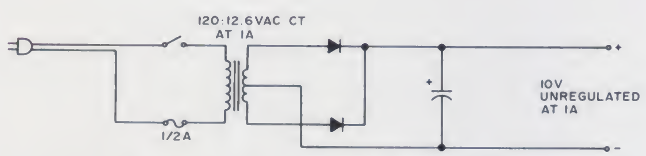

Fig. 1. The console unregulated power supply.

Overvoltage Protection

A power supply is a group of circuits, or modules, that together must perform a specific task. It is comparable to a chain. If anything goes amiss, the weakest link in the chain will break. The fuse is an example of a link that is *intended* to break, and thus protect other components.

One of the links in the power supply circuitry is the series pass regulator element. It can short-circuit. If this happens, it is almost always a short from the input to the output. This short will place unregulated dc on each and every component connected to the power supply. The major investment on your part in the computer is the microprocessor chip and the memory chips. This will be roughly 90% of the dollars invested in the central processor (CPU) portion of your computer system. The power supply voltage to the microprocessor and the memory chips must never exceed 7 volts. Any voltage in excess of 7 volts could instantly wipe out your entire computer and all the expensive chips. To prevent such an occurrence, overvoltage protection circuitry can be incorporated into the power supply. This is a circuit that *senses* the 5 volt power supply line, and if this line ever exceeds about 6 V dc, the circuitry instantly removes supply voltage. Such a circuit, called overvoltage protection circuitry, is built into some of the computers currently offered by manufacturers. The Processor Technology SOL-20 is one example of a computer that incorporates this feature.

Since I am a very cheap individual, and I happen to know from your correspondence that many of you following the Klassroom are already operating your systems, I feel that overvoltage protection for your investment is a number one priority. I could wait until later to include this circuitry, but if I can save any of you a few dollars, then it belongs here, and not later in the series.

Experiment #28
The SCR

Problem: How can I add overvoltage protection to my power supply?

Solution: Use a silicon controlled rectifier (SCR) to blow a fuse that feeds the regulator element.

Procedure: Refer to Fig. 2. Fig. 2a shows the electronic symbol for the SCR. Fig. 2b shows the basing of some typical SCRs. (The basing of the particular SCR that you use will be included with the SCR or can be found in data manuals.) Fig. 2c shows the test circuit that I want you to use to find out what the SCR does. Connect the circuit of Fig. 2c on the console breadboard.

Theory: A silicon controlled rectifier is one member of a family of 4-layered devices. An ordinary diode has two layers, one positive (P) and one negative (N). We say that a diode is a PN device. A transistor has three layers, either PNP or NPN. The 4-layered devices, such as the SCR have either a PNPN or NPNP configuration.

The SCR is connected to the circuit in a forward-biased configuration: plus to the anode, and minus to the cathode. Even though it is connected with forward bias, it does not conduct. It is an open circuit. To make it conduct, a small forward bias must also be applied to one of the four layers. This trigger layer is called the gate. A small current into the gate turns on the SCR, and for all practical purposes, connects the anode and cathode of the SCR together. Once the SCR is turned on by the small current on the gate, the SCR remains on even if the gate current is removed. This is called latching. The jumper from plus 5 to the current limiting resistor connected to the gate element will inject current into the SCR, turning it on. Once on, the SCR latches, and even though the gate current is then removed, the LED will remain on.

To turn the SCR off and unlatch it, the current *through* the four layers must be interrupted. To interrupt the current and turn the LED off, remove the LED from the circuit. This breaks the current path, and when the LED is reinserted in the circuit it will remain off until you again trigger the gate. You can also break the current path anywhere between plus and minus and accomplish the same thing.

A second way to turn off the SCR is to bypass the current around it. The current flowing through the SCR is what causes it to latch. If a jumper is placed around it the current no longer flows through the SCR but through the jumper instead. The SCR will unlatch and the LED will go out and remain out until you trigger the gate again. As with any diode operated with forward bias, there is a voltage drop across the diode, and the anode of the SCR will be a few tenths of a volt above ground.

The SCR is similar in its operation to a latching relay, but with one very important difference: The SCR is a semiconductor device and is very fast. The relay is an electromechanical device and is very slow by comparison.

Experiment #29
The Overvoltage Circuit

Problem: How can an SCR provide overvoltage protection for my power supply?

Solution: Use an SCR to blow a fuse, thereby removing power to the regulator circuitry.

Procedure: Refer to Fig. 3. This is a test circuit for the overvoltage protection circuit. We will need to modify the console power supply by opening some circuits and bringing wires up from underneath the console so they can be plugged into the breadboard to perform the experiment. After we do the experiment and understand how the circuit works (and prove that it works), we will incorporate it permanently into the console power supply.

Disconnect the input terminal of the LM 309K (or 7805) from the output of the power supply. Disconnect the ground terminal of the LM 309K from minus (see Fig. 3a).

Bring two wires up from below the console. Make them long enough to reach the breadboard from the power supply output and the input terminal of the LM 309K. Bring one wire up from the ground terminal of the LM 309K. Plus 5 and ground from the power supply itself remain available at the feedthrough bolts on the front panel of the console.

Now set up the circuit of Fig. 3c on the breadboard. The 1k to 5k variable resistor between the LM 309K ground terminal and power supply minus should initially be set for zero Ohms. As this resistance is increased, the regulated +5 volts out of the LM 309K will rise. When the voltage on the +5 volt line rises high enough to reach the zener voltage, the zener diode will begin to conduct, and the voltage across the 1k resistor in series with the zener will begin to increase.

As this voltage begins to increase, current will begin to flow into the gate terminal of the SCR. At some point around 6 volts out of the LM 309K, the SCR will fire. When the SCR fires, the pilot light (try a #47 or #44 lamp) will illuminate. If you now measure the output voltage of the LM 309K, you will find it very near ground. With the SCR latched on, you have essentially a short circuit through the SCR to minus. The LM 309K has almost no voltage on its input terminal, so there is no output voltage.

Return the 1k pot in the ground return circuit of the LM 309K to zero Ohms. Reset the SCR to off. Either jumper across the SCR or break the current path through it by opening one of the leads. Repeat the overvoltage output-SCR firing sequence by again raising the output of the LM 309K and increasing the resistance between the LM 309K ground terminal and power supply minus. The SCR should again fire and illuminate the pilot lamp.

Once you are convinced that the circuit functions correctly you are ready to install it under the chassis. Reconnect the LM 309K ground terminal to minus. The lamp in the test circuit will be replaced with a fuse. Add another fuse holder under the chassis and connect a 1-Amp fuse in place of the lamp that was used for the test. *Do not eliminate the ½-Amp fuse in the primary of the power transformer.* This fuse is protecting your house from burning down. Add the second fuse so that if the +5 volt line on your power supply ever exceeds about 6 volts, the SCR will fire and blow this 1-Amp fuse. Fig. 3d gives the final modified circuit that is incorporated into the console power supply.

I could stop at this point and let the rest of you figure out how to add this to your computer power supply, but if I did I would end up answering another several hundred letters. So let's see if I can give you the rest of the information, and save myself a lot of writing.

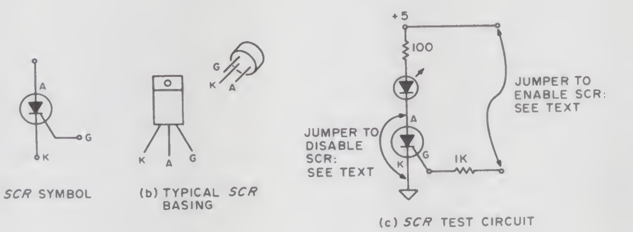

Fig. 2. SCR symbol, basing and test circuit.

Experiment #30 Heavy Current Overvoltage Protection

Problem: Hey, George, I have the Design Console (rather than the Student Console) power supply. How do I add overvoltage protection to it? Or how do I add it to Brand X power supply?

Solution: Use a heavier current SCR and a trigger boost circuit.

Procedure: Refer to Fig. 4. The fuse is replaced with one equal to the current capacity of your power supply. A heavier current SCR is now required as well. Since a heavier current SCR requires more gate injection current to turn it on, the voltage on the +5 volt output line will have to rise higher to produce a larger voltage drop across the 1k resistor in series with the zener diode in order to fire the heavier current SCR. There are several things that could be done to overcome this problem, but we already have a tested and proven circuit using a zener diode and an SCR. Therefore, the simplest and best solution is to use the circuit that we have already proven, and add the heavier current SCR. The original SCR that we have already proven in our test circuit is used to fire the added heavy current SCR. The trip point therefore will remain exactly as it was in our test circuit, and the second SCR will blow the heavier fuse just as rapidly as our original circuit illuminated the lamp.

To test the heavier current overvoltage protection circuitry we can apply the same procedures used to test the Student Console power supply. Basically, the output +5 volt line must be raised under controlled conditions, the zener diode placed into conduction. The first SCR fires and it in turn fires the second SCR. You can use the lamp again in the test, or you can just go ahead and blow the fuse to prove that your circuit will shut things down if the output line ever exceeds about 6 volts dc.

Why Do I Keep Jumping All Around?

Why do I keep bringing in apparently stray topics instead of sticking to digital electronics? We are going to build a computer at the end of this series. If we are going to have half a chance to accomplish this goal in approximately one year of Kilobaud Klassroom, I have to find some way to cover everything we are going to need to get the job done. One approach is to write separate articles for some of the techniques that we will need. This approach has been used. Another possible technique is to have some of the material published in another magazine. This approach has also been used. As letters from the readers provide feedback about their problems (and solutions), I get this information into print in whatever fashion I can. So even if it may appear that I am straying from the original course of action set forth in issue #5, I request your indulgence. Everything we are doing is in some way directly related to the end product of the series.

Experiment #31 A Touch Control

Problem: Hey, I'm tired of all this heavy stuff. How about some fun?

Solution: Oops! Sorry about that. Well, how about a touch control?

Procedure: Refer to Fig. 5. The original circuit appeared in the 1975 *Signetics Application Manual*, which accompanied their data manual.

Connect the circuit of Fig. 5a on the console breadboard. Each time your finger touches the point marked input, the 555 will produce a pulse which will light the LED. Next, increase the value of the 100k resistor in the circuit to around 1 Meg. Now when you touch the input the LED will appear to be on continuously. Your body is surrounded by 60-cycle power lines. It picks up some of the 60 cycles. When you increase the input resistance here to 1 Meg or so, this 60 cycles will continually fire

the 555, and the LED will reflect this by flashing on and off at the line frequency. Replace the 100k resistor.

Add a flip-flop as shown in Fig. 5b. Connect LEDs to the Q and $\overline{Q}$ outputs of the flip-flop. Now each time the input to the 555 is touched, the flip-flop should toggle.

Now add the circuitry shown in Fig. 5c. This converts our experimental circuit into a practical circuit. The relay here must be a dc type. An ac relay is not suitable, and a 120 V ac relay is downright dangerous! Touching the input to the 555 toggles the flip-flop, which turns the 8T90 power inverters either on or off. The 8T90 controls the relay. The diode across the relay coil may be any silicon diode: It is used to suppress the voltage spikes generated when the magnetic field of the relay collapses. This is one of the primary uses for the 8T90 chip. The relay voltage and its power supply may be anything up to 28 V dc. The 7406 may also be used here up to 28 V dc. The 7416 can be used here with a 12 volt supply and a 12 V dc relay. Each section of the hex inverter added in parallel increases the available current to operate the relay coil. If one section will supply sufficient current to operate the relay coil, then only one section need be used. Try three sections in parallel to start, then eliminate one and try again. If the relay still functions, then try just a single section.

For the input to the 555, Signetics suggests a metal plate at least two inches square. If you wet your finger with a little saliva, and then touch it to the input wire, I think that you will find that the 555 will trigger. If not, then follow Signetics' suggestion and add a brass or copper plate to the input wire and touch that.

This is a *body capacitance* operated circuit. When you touch the input line to the 555 chip, you discharge the .01 capacitor and pull pin 2 low. Pin 2 of the 555 is the trigger input to the chip, and a negative-going pulse on pin 2 will trigger the 555 to output a pulse. This pulse width is governed by the 10k and .01 capacitor on pins 6 and 7 of the 555. These values may be increased to widen this output pulse and make it easier to see on the LED monitor on pin 3.

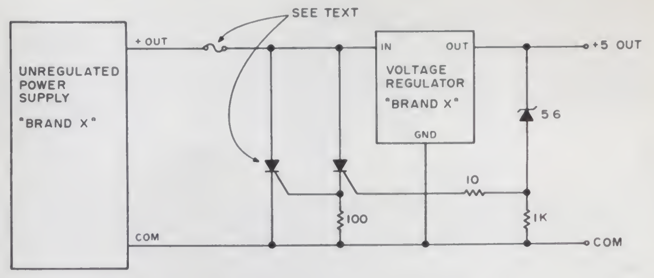

Fig. 4. Adding overvoltage protection to "Brand X."

Experiment #32
Relays

Problem: We just used a relay in an experiment. How do they work?

Solution: Let's get one on the breadboard and investigate them.

Procedure: This time let's build the theory up first then do the experiment.

Theory: In elementary school science classes, the electromagnet is usually introduced. A nail is wrapped with several hundred turns of insulated wire and the ends of this wire are connected to a dry cell. The nail becomes magnetized and picks up iron filings. Disconnecting the source of power to the electromagnet de-energizes the magnetic field and the iron filings drop off. This is basically what is drawn in Fig. 6a. The rectangle represents the iron nail, or in any relay symbol it represents the ferromagnetic material of the relay coil. The loops represent the wire wrapped around the iron core. We are going to draw our relays the way hams draw them. Some methods of drawing relays leave a great deal to be desired as far as providing understanding of how relays function.

In Fig. 6a we call the assembly the *coil assembly*. The iron core is called a *pole piece*. The number of turns of wire and the size of this wire determine how much current will flow through the wire, and consequently determine the operating voltage of the coil assembly.

Fig. 6b shows a piece of iron called the *armature* which is pivoted on one end. When current flows in the coil assembly, the pole piece is magnetized, and the armature is drawn toward it.

Fig. 6c adds a spring to the armature to pull it back to its original position after the magnet is de-energized. This spring complicates things, but it is necessary. The relay must have some restoring force to return the armature to its original position after the energizing current is removed. The addition of the spring means that it now takes a stronger magnetic field to pull in the armature, since we must now overcome the spring tension in order to pull in the armature. Thus the pull-in force, the release force, and the holding force are all different. This force is supplied by the current in the relay coil; so we are really saying that there are three different currents flowing in the relay coil at different times.

Since the current changes, this means that the operating voltages can change as well. A 12 volt relay is one that will pull in its armature with 12 volts applied to the coil. Once the armature is closed (pulled in) the relay does not need as much current to hold the armature closed. If the voltage is reduced we will find

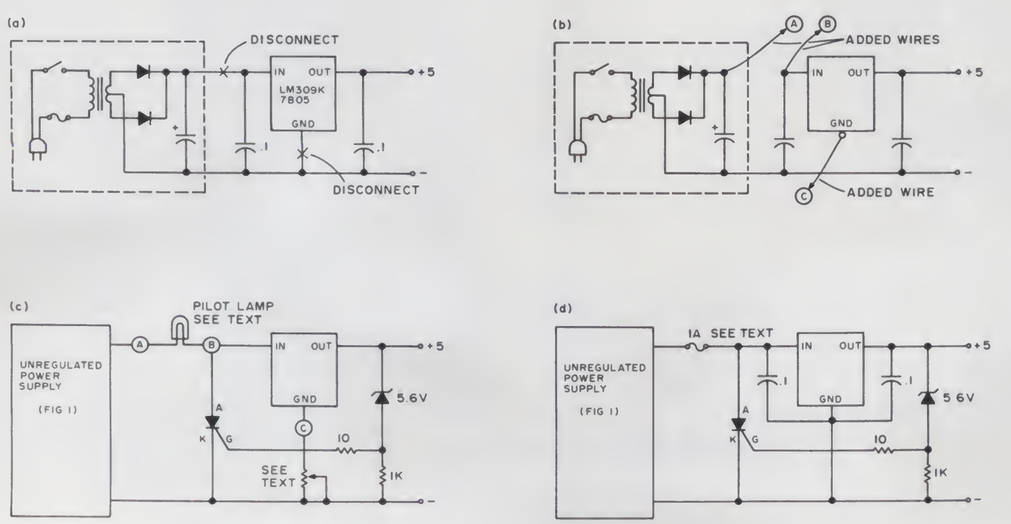

Fig. 3. Overvoltage test circuits and power supply modifications.

that even at 9 volts, the relay remains closed. As the voltage (and therefore current) is reduced still further, we will reach some point where the magnetic field of the relay will no longer be strong enough to overcome the spring tension, and the relay will drop out (the armature will return to the de-energized position). Since voltage is still applied to the coil, current is still flowing in the coil, but the relay does not now have enough current to provide a strong enough magnetic field to overcome the spring tension.

The spring must be there to make the relay operate. However, the spring is normally not drawn in the relay symbol. Fig. 6d adds an insulator and a set of contacts to the armature. Now when we energize the coil assembly, the armature pulls in and closes the switch contacts, completing an electrical path. When the coil assembly is de-energized, the spring pulls the armature back, breaking the electrical contacts and opening the circuit path. We don't normally draw the armature in the relay symbol either. Fig. 6e shows only the relay contacts; the armature has not been drawn. Fig. 6f adds another set of contacts. The pole piece pulls the upper contacts down, and the lower set of contacts up.

Fig. 6g adds more contacts — a set of contacts that *breaks* upon relay energizing, in addition to a set of contacts that *makes* when the relay is energized (the dotted line indicates the contacts move together). Now you can begin to see why relays are so widely employed. A single switch can be used to control the current through the relay. The relay itself can have many sets of contacts that perform all kinds of switching operations. Fig. 6h shows a complete relay coil assembly, with two sets of contacts, being used in a very non-digital manner (forgive me).

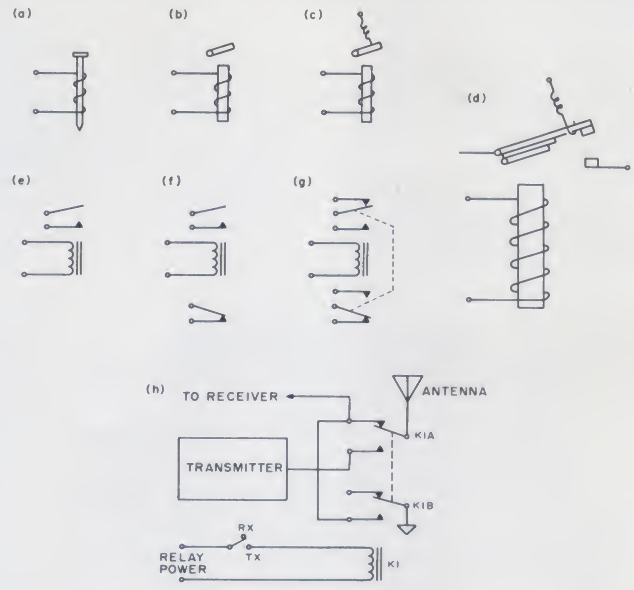

Fig. 6. Relay development.

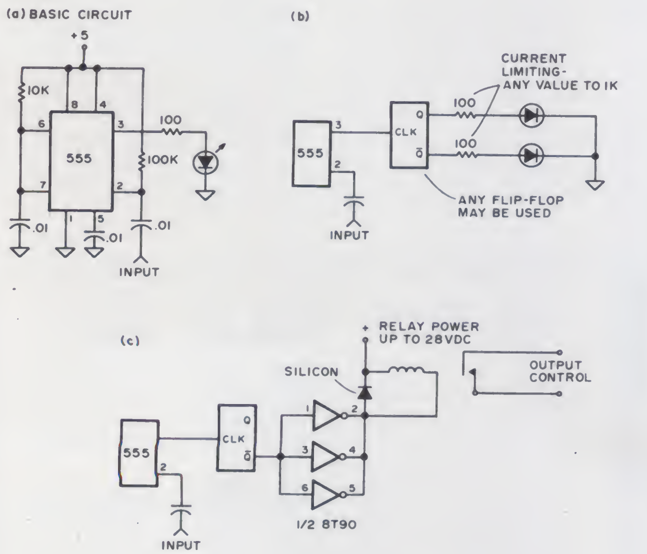

Fig. 5. Touch control circuit.

Fig. 7 shows a relay controlled by two push-button switches. This is a standard circuit used in industrial control. It is also used on some computers as the off-on control. Wired as shown in Fig. 7, the relay functions as a latching relay similar in operation to the SCR circuit of experiment #28.

The normally open start switch feeds current through the normally closed stop switch. This current energizes the relay coil and pulls in the armature. One set of contacts is wired in parallel with the start switch. As soon as the relay closes, the start button may be released; current will now flow through the relay contacts to hold the relay latched closed. The normally closed stop switch will break the current path to the relay coil when it is depressed and the armature will drop out, breaking all the relay contacts, including the holding contacts, and the relay will unlatch. Note that this circuit uses a 120 V ac relay. To operate a relay on 120 V ac, either the ac must be changed to dc to operate the relay coil, or the pole piece must be a special pole piece designed for ac operation.

This type of circuit has a place in computers because if the ac power line should drop out long enough for the relay to unlatch, the entire computer will be de-energized and remain off until manually put back into operation by the operator. This could prevent extensive damage to devices connected to, and controlled by, the computer.

You need a relay and a source of power for it. Add wires to the contacts that will plug into the console breadboard. Do not use a 120 V ac relay for experimenting — it's too dangerous. If you want to try the industrial relay control of Fig. 7, then do not try it on the console. Wire up the 120 V ac relay and the two push buttons on some kind of a separate chassis or block of wood and operate it by itself. The circuit in Fig. 7 may be used on the console by using a relay that will operate on 5 volts. I recommend this learning procedure since I certainly don't want to lose any of you at this point.

We've mentioned one use of relays in computers. Another common application is the use of a relay to control cassette tape drive motors under program control. Re-

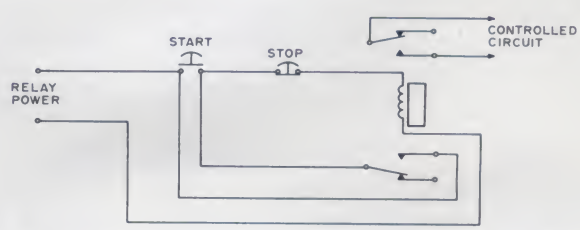

Fig. 7. Push-button relay control: Industrial version uses 120 V ac or 220 V ac relay power and relay.

lays can be used whenever you want to electrically or physically isolate one electronic circuit from another.

Kilobaud Klassroom Komment

Questions concerning the length of this series have come up several times. The targeted length is approximately one year. In that time we are going to attempt to take you from zero to the construction of an operable computer — a pretty ambitious undertaking.

We have a beginning, and we now have a place to send the newcomer to get him started. No matter how long you remain in electronics, you will never learn it all. That was possible once, but that time is past for good. No matter how much you learn, something new will be invented, necessitating your continual education. Far from being discouraged by this turn of events, you should be elated. Electronics can never become mundane when the technical knowledge in this field is doubling approximately every two years. So do not worry that you will never learn it all. Just accept the fact and enjoy learning as much as you can — or want.

Photo 1. What it is all leading up to. The KK Komputer during the design stages. (Don't ask what chip. Big secret!)

Preview

In Kilobaud Klassroom No. 7 we will take an in-depth look at the stuff I told you to start scrounging back in session 1. We'll learn how to test those transistors that you have been salvaging and storing, waiting for me to get around to telling you what to do with them. (If I don't do this pretty soon, then you'll probably start calling me all kinds of nasty names.) So get that stuff cleaned up and off the circuit boards; get ready to find out what you've got and what you can do with it.

For session 8, we will need the use of an oscilloscope. Do not run out and buy one. If you have one, fine. If not, then start scrounging around now and locate one of those resource persons that I told you about earlier. We will need him and his scope. We'll also need a one-shot multivibrator chip. The 72121, 74122, or the 74123 will do. And we will need a couple of 74161s, a 74150, and another 8T90. Sierra Electronics, Box 11, Auberry CA 93602 has this package available for $5 postpaid, including shipping and handling. California residents, add 25¢ sales tax. ■

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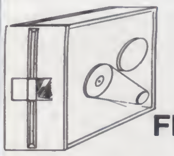

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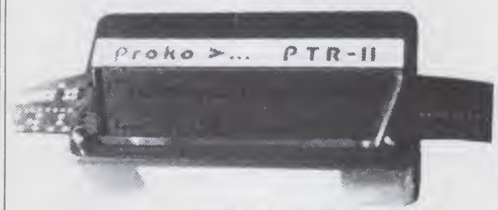

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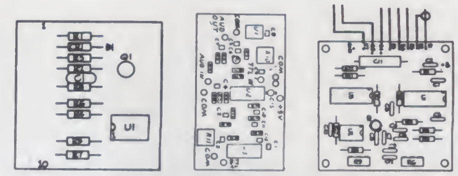

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8T13	2.50	8T110	2.00	81L22	1.50
8T16	2.00	5309	8.00	82L23	1.90
8T20	2.50	5312	4.00	85L51	2.50
8T24	2.50	5313	4.00	85L52	2.50
8T26	2.50	5320	5.95	85L63	1.25
8T34	2.50	5554	1.90	86L70	1.50
8T37	2.50	5556	2.50	86L75	1.90
8T38	2.50	5055	1.60	86L99	3.50
8T80	2.50	MC4044	2.25	88L12	.80

74L00	.25	74LS00	.40	1101	1.25
74L01	.25	74LS01	.50	1103	1.25
74L02	.25	74LS02	.40	2101	4.50
74L03	.25	74LS03	.40	2111-1	3.75
74L04	.30	74LS04	.45	2112	4.50
74L05	.40	74LS05	.45	2602	1.60
74L06	.30	74LS08	.40	4002-1	7.50
74L08	.40	74LS10	.40	4002-2	7.50
74L09	.40	74LS12	.55	MM5262	1.00
74L10	.30	74LS20	.40	7489	2.00
74L20	.35	74LS22	.45	74200	4.95
74L26	.40	74LS27	.45	74C89	3.00
74L30	.40	74LS30	.40	82S06	2.00
74L32	.45	74LS37	.60	82S07	2.00
74L42	1.50	74LS38	.60	82S17	2.00
74L51	.35	74LS42	1.50	8223	2.50
74L54	.45	74LS51	.40	82S23	3.00
74L55	.35	74LS54	.45	82S123	3.00
74L71	.30	74LS55	.40	82S126	3.50
74L73	.55	74LS73	.65	82S129	3.50
74L74	.55	74LS74	.65	82S130	3.95
74L75	1.20	74LS76	.65	82S131	3.95
74L78	.90	74LS151	1.55	IM5600	2.50
74L85	1.40	74LS174	2.20	IM5610	2.50
74L86	.75	74LS175	1.95	IM5603	3.00
74L89	3.50	74LS192	2.85	IM5604	3.50
74L90	1.50	2501B	1.25	IM5623	3.00
74L91	1.50	2502B	3.00	IM5624	3.50
74L93	1.70	2507V	1.25	MMI6330	2.50
74L95	1.70	2510A	2.00	DM8573	4.50
74L98	2.80	2517V	1.25	DM8574	5.50
74L123	1.50	2519B	2.80	DM8575	4.50
74L164	2.50	2532B	2.80	DM8576	4.50
74L165	2.50	2533V	2.80	DM8577	3.50
74L192	1.25	DM8131	2.50	DM8578	4.00
74L193	1.20	N8263	3.50	2.4576 MHZ	
MH0026	2.95	MC1489	1.50	XTAL	7.20
MC1488	1.50	DM8837	1.50		

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John Blankenship
Professor, Computer Technology
De Vry Institute of Technology
828 W. Peachtree N.W.
Atlanta GA 30308

Photo 1. The KIM-1 System.

Photos by Thomas Snider

Expand Your KIM!

. . . with Altair bus devices

If you're lucky enough to be a KIM owner, or plan to be, this is the first in a series of articles that will show you one approach to expanding your one-board computer into a full-blown, unbelievably versatile, reasonably priced system.

If you have already spent your money on a 6800, do not despair. The information will be in a general format so that it can be applied to other processors.

You'll learn, for example, how to interface Altair bus peripherals, such as memory or a TV Dazzler, to a general bus.

A Southwest Tech keyboard and 40-column printer will become a miniature Teletype.

A software driver for the Dazzler will turn it into a television typewriter with up to ten 32-character lines that are readable at classroom distances. Since a class can read the output, I will later discuss some educational software.

My articles will not be just schematics and program listings. Being a professor of computer technology, I hope to generate some thought on your part. I will tell you how,

Photo 2. The front panel includes everything from sense switches to joysticks.

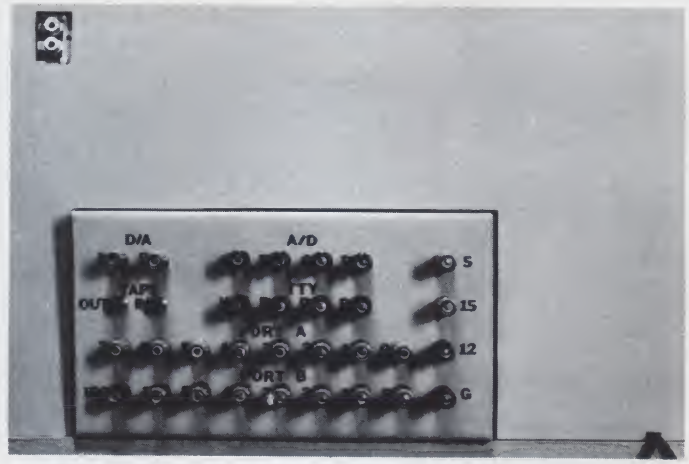


Photo 3. A backplane of banana jacks provides easy interfacing for experimenters.

but I'll emphasize why and even why not.

I will assume that you have a general knowledge of digital electronics. If you feel lacking in this area and you wish to build a KIM-1 System, I suggest you study the previous "Kilobaud Klassroom" articles by George Young.

If you want to really understand your system, you will appreciate my approach. If you want a step-by-step, solder-this-wire-here format, do yourself a favor and stick to kits and canned programs.

Most computer hobbyists do just that. They purchase a general kit consisting of a CPU board, power supply, limited memory, and a front panel. Once they get it up and running, some form of I/O device such as a video terminal usually is next on their list. After discovering how long it takes to reload their favorite program, they soon acquire a cassette interface. I've found that these units are what most hobbyists consider a "complete" system. The newest kits on the market are evidence of this, as they offer all the above in a single package, and perhaps on a single board. The cost of such a system will very depending on which manufacturer you choose, but in most cases a complete system as described above will cost between $1000 and $2000.

I have wanted a personal computer for a long time and therefore have had a chance to develop a large variety of uses and reasons for owning one. Since I am a teacher, I wanted to learn as I built my system, so that the knowledge of microprocessors would not pass me by. I also wanted to be able to demonstrate various hardware and software concepts in the classroom. Naturally, the enjoyment of programming my own games and perhaps even using the system for practical things like averaging grades or as a real-time visual aid was also a priority.

To be effective then, my system would have to be much more than just complete. In addition to the parts previously mentioned, I wanted a hard copy output, A/D and D/A converters, joysticks, color graphics and some convenient means of temporarily connecting any of the capabilities to external equipment, in case the urge to experiment hit me.

Not only did I want all of the above, but I required it to be contained in one portable enclosure, at a total cost of less than $1500. As impossible as it sounds, I have built such a system, with even more capabilities than I had hoped, for $1300.

Fig. 1 shows the basic block diagram. The heart of the system is the KIM-1. Since many articles have been written on it, I'll not bore you with a rehash of its capabilities. A *bus control* board generates the necessary signals to interface KIM to a modified Altair bus. I have no intention of claiming that every 8080 peripheral made will operate on this bus, but you should have no trouble with many boards.

A 4K memory board has been modified to operate in K1 through K4 using the KIM on board decoding, thus providing the proper memory locations for Tiny BASIC

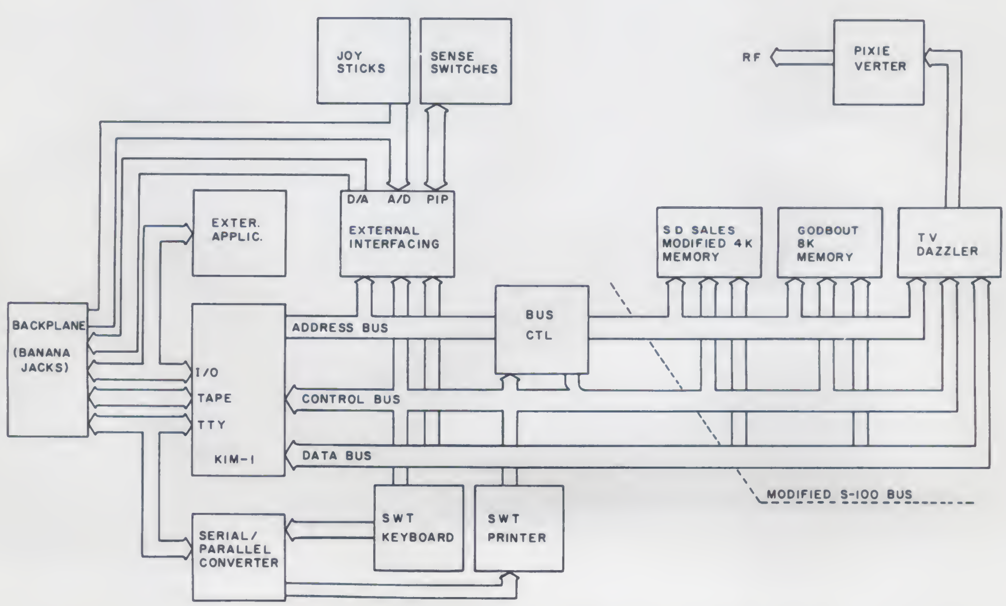


Fig. 1. A block diagram shows the completeness of the KIM-1 System.

Photo 4. The top and back panels are easily removed for access.

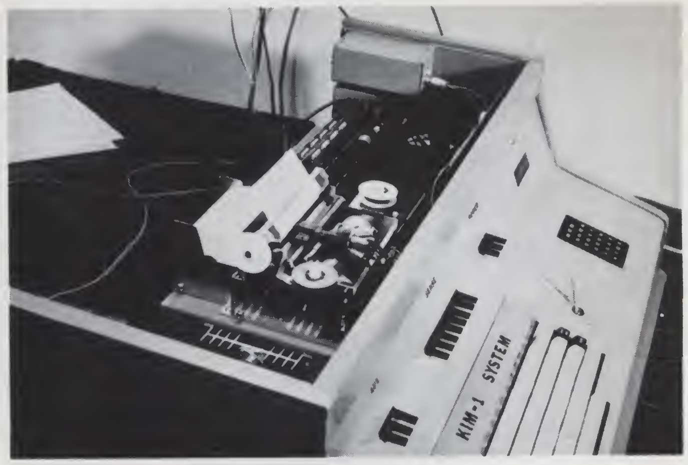


Photo 5. Hard copy is provided by a 40-column impact printer.

with a little extra space for user subroutines and the TVT driver.

The 8K memory board uses the first 2K as display memory for the Dazzler, and the remaining 6K for user programs. Of course, the entire 13K (K0 is on the KIM-1) is available for user programs if assembly language is used.

The *serial/parallel converter* board converts the SWTPC keyboard and printer into a miniature Teletype. Since the printer dumps a line at a time, true TTY operation is not possible, but the TVT driver mentioned earlier will greatly lessen most of the disadvantages.

The *external interfacing* board provides an input port for the sense switches and the A/D and D/A circuits. This board is based on the assumption that the hobbyist doesn't need 100 percent accuracy if he can approach it for a fraction of the cost. It does provide true A/D (the input is a voltage not a resistance), which makes it much more versatile for experimental applications.

And, speaking of experimental applications, a backplane is provided to allow the system's capabilities to be easily connected to temporary circuits for demonstrations and prototypes.

Although the KIM nondedicated I/O ports are wired to the backplane for experimenting, they also connect to a 44-pin edge connector to allow more permanent applications. One application example is a super simple ($20) 30-function calculator interface as described in an issue of *KIM User Notes*.

Photo 1 shows the cabinet, which is 30 inches long and is completely self-contained. An RF modulator is built in so that any television may be used for the video display. I named the system KIM-1, after its CPU board.

A closeup of the front panel is shown in Photo 2. Both ASCII and hex keyboards are provided and are under ROM control. The hex keyboard also provides troubleshooting aids, such as single step and internal register interrogation.

In the upper right corner is a six-digit seven-segment display. Under ROM control the display is in hexadecimal, but can be programmed on a segment-by-segment basis, providing nearly unlimited uses.

The toggle switches are grouped as auxiliary (general purpose), power (self-explanatory), and sense. The sense switches, being connected to an input port, provide an easy means of interfacing with the software.

The joysticks are permanently mounted on either side of the ASCII keyboard. Their digital outputs are read by the processor as normal memory locations.

Photo 3 shows a closeup of the back panel. Two nondedicated I/O ports, interrupt, A/D, D/A and tape recorder outputs are readily available. Four jacks even provide 20 mA loop signals so that a TTY can replace the internal printer and keyboard. The RF and video outputs for the television can be seen in the upper left hand corner of the panel.

The back and top of the cabinet (Photos 4, 5, 6) are easily removed, and provide access for assembly and troubleshooting.

Hard copy is provided by the 40-column impact printer. It mounts on a steel frame that acts as a magnetic shield for the power supply transformers.

One end of the cabinet is empty and can be used for future expansion, such as the permanent mounting of a tape drive.

The entire mainframe is removable (Photo 7), and consists of six 44-pin and four 100-pin connectors. All major circuits of the computer proper are mounted on this frame.

In order to keep the cost to a minimum, I explored the many products available, looking for those that offered the maximum return for the dollars invested.

Table 1 summarizes the chosen products and lists the approximate costs for each. Each product was carefully analyzed and, at least in my

KIM-1 MOS Technology	$245
Dazzler Cromemco	215
Memory-4K SD Sales	90
Memory-8K Godbout	165
Printer (40-column) SWT PC	250
Keyboard SWT PC	50
Other miscellaneous components	285
TOTAL	$1300

Table 1. The 13K KIM-1 System, complete with joysticks, hard copy and color graphics costs only $1300.

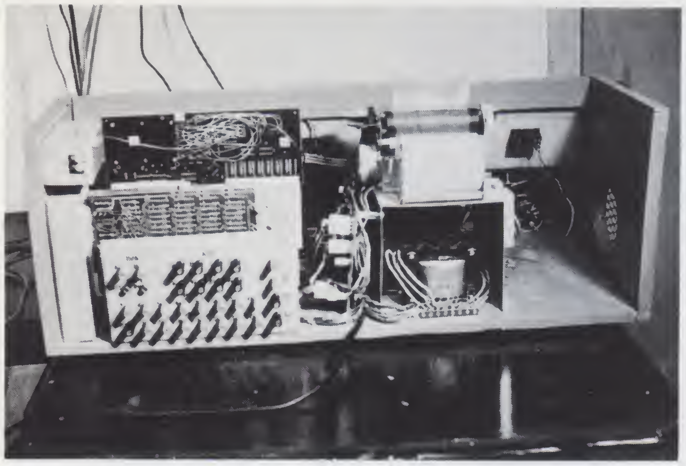


Photo 6. One end of the cabinet is empty and can be used for future expansion.

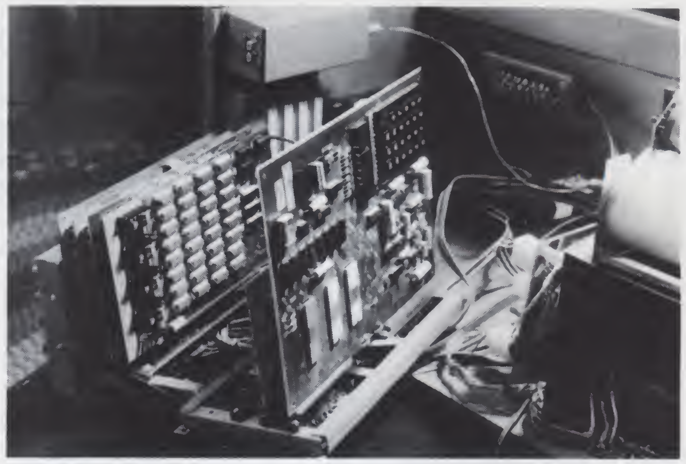


Photo 7. The entire mainframe can be removed for troubleshooting.

opinion, individually provides more for your money than most products on the market. Table 2 lists some of the miscellaneous parts so that those interested in building the system can begin collecting the hardware.

I guess *individually* was the key word in the last paragraph, because none of these units were meant to be used together. After many weeks of studying schematics, buses, etc., I developed several simple but effective circuits that would enable all the units to operate together as a system.

And it is a system I call complete. I have both hard copy and video text. The fifteen colors of graphics have three levels of software-controlled resolution. The joysticks, with their two-dimensional movement, provide more realistic participation in video games. The ASCII and hex keyboards provide a versatility I've come to appreciate. The cassette interface operates without failure and can load all 13K of memory in under five minutes.

If you like experimenting, the backplane of banana jacks is a dream come true. Although the cabinet is not small, it is far more portable than most other systems with similar characteristics.

I considered a ROM board, but have rejected it. A full discussion of this decision will come at a later date. For those with conflicting philosophies, a piggy-backing of the dazzler boards will free up one Altair slot for ROM or perhaps a 16K RAM.

The empty end of my cabinet can hold a small disk, but I'm waiting to see how bubble memories turn out. Their application as a "solid state" disk intrigues me very much.

One advantage that you will have over most hobbyists is that if you build this system you will understand it. My detailed studies of each unit have shown me their capabilities and their weaknesses, and I hope to include as much of this knowledge as possible in my articles. I have concluded this is a system I won't soon become bored with, and I look forward to many happy hours watching my programs come to life as they control the many I/O peripherals.

I'm already dreaming up unusual displays, demonstrations and games that will push the system and my programming abilities to their limits, and that's what having a hobby computer is all about.

I've spent a lot of time developing my system to the point where I believe it provides more than any other hobbyist system at any cost. less of cost.

Next month I will provide the information on the construction and wiring of the mainframe, power supply and cabinet.

The articles then will get more educational as the bus control, serial/parallel and external interfacing boards are discussed separately and in great detail.

After that, I will turn to software. Each program will be selected in part to insure that builders of the KIM-1 system can fully utilize each of the peripherals.

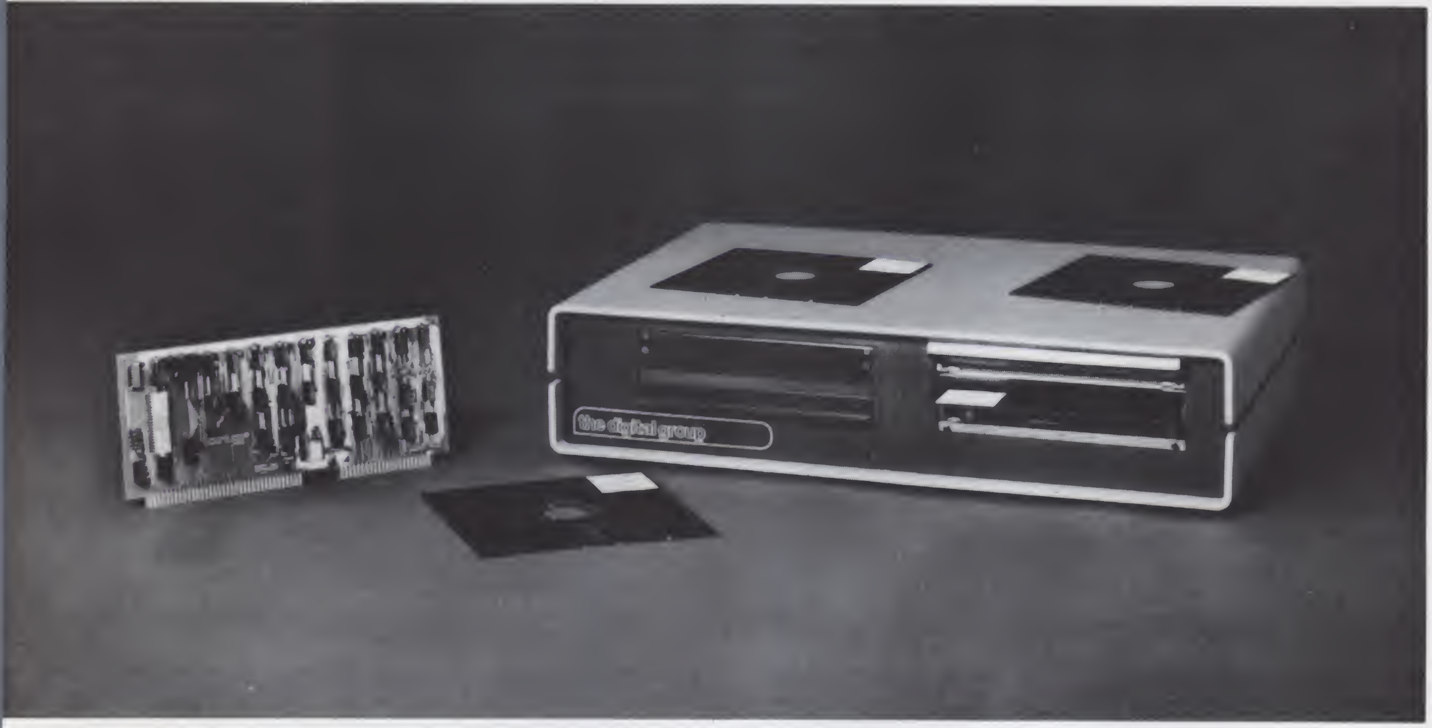
In keeping with my desire to maintain a general tone, the software articles will be heavy on organization and strategy, and I hope, will be useful to many non-6502 owners.

I'm convinced that the 6502 is going to become the most popular hobbyist processor. As you read my future articles, I think you'll see why. ■

14	DPDT toggle switches.
2	100K joysticks.
2	6.3 V 10 Amp CT transformers.
2	15 Amp silicone diodes, heat sinked.
1	12 Amp bridge rectifiers, heat sinked.
2	1 Amp bridge rectifiers.
2	1 Amp +5 V regulators, heat sinked.
1	1000 uF filter capacitor.
1	100000 uF filter capacitor.
1	1 Amp +12 V regulator.
1	14-pin IC socket (solder).
2	16-pin IC sockets (solder).
1	8-pin IC socket, wire wrapped (ww).
21	14-pin IC sockets (ww).
13	16-pin IC sockets (ww).
1	40-pin IC socket (ww).
1	6-switch DIP.
1	4-switch DIP.
2	16-pin IC plugs.
6	common anode 7-segment LEDs.
1	KIM keyboard.
1	4-slot Imsai motherboard.
4	Imsai 100-pin edge connectors.
4	feet, 40-conductor ribbon cable.
11	black banana jacks.
19	red banana jacks
2	phono jacks.
6	44-pin edge connectors.
4	44-pin plug in ww boards.
1	Pixie Verter (RF modulator).
ICs	4, 7400; 1, 7402; 1, 7404; 1, 74LS04; 1, 7408; 1, 7410; 1, 7420; 1, 7472; 1, 7476; 1, 7492; 1, 7493; 2, 74LS170; 1, LM339 (quad comparator); 3, 741 (op amps); 5, 8T97B (Tri-state buffers); 4, 4042BE; 1, 2502 (UART); 1, 1408L8 (D/A converter); 2, 74193.

Table 2. Summary of miscellaneous components.

NOW, DISKS TOO!



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Sherman P. Wantz
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Enhance Your Memory

. . . with home information retrieval

Six months ago, when I was trying to convince my wife that we really needed a personal computer to keep track of things around the house, I knew very little about what the devices were supposed to be able to do. In fact, I had never seen one.

All I knew for certain was that a microcomputer contained a memory. That fact alone was good enough for me because I was convinced that I was slowly but surely losing mine.

For me to say, "I'll put this paper where I'll be sure to find it when I need it," was the kiss of death. That paper was doomed to be forgotten and lost forever.

So what could have been more logical than to use a computer to supplement my own memory? Everyone living in the twentieth century knows that a computer has the ability to recall facts and figures, right?

At that time, I didn't know that programmers had sold computer hobbyists on the idea that if a computer isn't busy computing something, it simply isn't worth having around.

It wasn't until I began to assemble my SWTPC 6800 system that I started reading books, magazines, and newsletters that told me a micro was for playing games, turning gadgets on and off, solving math problems and (rarely) calculating payrolls and doing bookkeeping chores for the small businessman.

But that message reached me too late. Like a politician, I was trapped by my campaign promises. Unlike a politician, I felt duty-bound to live up to my promises for a better world through microcprocessor technology.

So far, I've passed the ultimate test. My wife is totally satisfied with the many uses I've devised for the 6800 — and I haven't scratched the surface of the list of opportunities for the computer to help us here at home.

Sooner or later the companies that market microcomputers are going to run out of customers who can afford to justify their purchases on the basis of the computer's novelty or its ability to play games (even Startrek).

Some task that is useful — even necessary — is required.

In my ignorance, I discovered the need for a computer system, and I wasn't even looking for it.

I'd like to share that discovery with you in the hope that you can use its logic to justify your purchase of a computer or additional capabilities for your present system if you already own one.

You need remember one thing only: Demand that your computer use its memory to supplement the one you carry around in your head (particularly if you — as I did — seem to have misplaced it somewhere).

Computer Help for a Lost Wallet

What would happen if my wallet were lost or stolen? I carry lots of valuable (to me) stuff in there. Not money, of course, since I got hooked on hobby computers.

The thought provoked me to list everything of importance I carry in the wallet. The list took the form of a simple tabulation entered into the computer's memory, which would enable me to report what had been lost.

Then I entered the number and expiration date of my driver's license. I reasoned that a periodic review of the record would bring the expiration date to mind and preclude my allowing it to lapse.

I also entered the termination dates of my amateur and citizens radio service licenses. Both have to be renewed every five years and the Federal Communications Commission doesn't yet warn licensees of impending expiration.

Next, I entered the numbers on each of my credit cards, including the addresses to which notification is sent if the card is lost or stolen.

I also entered the numbers on my military I.D. card, library card, voter's I.D., fishing license, etc.

If my wallet is ever misplaced, I will know exactly which items are missing, and can begin the slow process of replacing them.

Safe Deposit Box

I have spent many frustrating hours searching through desk drawers, file cabinets, cupboards and "God's Drawer" (where I look in desperation after my good wife has prayed for help) for papers I had stored in my safe deposit box at the bank.

What better use for my computer than to list, for periodic reference, all of the documents I keep at the bank? Therefore, deeds, marriage certificate, wills, passports (and their expiration dates), discharge papers, etc., were entered in memory.

I also listed the name and address of the bank and the location of the two keys to

the safe deposit box.

A Word about Memory

When I say that I entered these lists into the computer's memory, I use the term "memory" in a special sense. I use the keyboard terminal, audio interface and tape recorder to enter the lists on a cassette tape.

The tape is my semi-permanent file, which is roughly equivalent to micro-filming the lists for record-keeping purposes.

Some other entries have also been made directly to cassette tape, bypassing the computer's memory. The SWTPC 6800's CT-1024 terminal system and the AC-30 audio cassette interface allow this procedure.

Many entries were made directly to memory, however, to take advantage of the computer's ability to file and retrieve taped information in response to specific inquiries.

Around the House

Twice since I bought my house, I've had to clean out the trap that catches grease from the kitchen sink. The first time, I dug up half the backyard trying to locate the grease trap. That's forgivable. But I was really upset when I couldn't find the sketch I'd made of the trap's location and had to dig the yard up a second time.

You can appreciate why the exact location of the trap and the date I last cleaned it became a high priority memory item.

Next, I entered the number of my home fire and storm insurance policy, name and address of the insurer, policy renewal date, and coverage limits. The location of the policy, and the insurance agent's name, address and telephone number were also included.

Since I did some inside home repair work and had a difficult time matching paint on the walls and ceiling, I have kept a record of the paint manufacturer, the color name and number used in each room for walls, ceiling and trim. I made similar entries for carpeting, wall-paper and drapery material.

A faucet in one bathroom develops a leak about once each year requiring replacement of a rubber seal. There is a bell-shaped metal cover I have to remove to get at the seal, and I've almost broken the faucet several times because the cover is held to a pipe with a left-hand thread.

Now I have a step-by-step procedure in my house repair cassette that describes exactly how to proceed with that simple, but aggravating, task.

Ever try to find warranties you received with your refrigerator, freezer, TV set, juicer, digital clock, radio, calculator, etc.? When the gadget failed, was it still under warranty? I've faced that question many times and found I didn't know the answer. Now, I have the warranty information, date of purchase, invoice number, price, name and address of the seller and guarantee period on tape.

I subscribe to lots (too many) of magazines. I'm a pushover for deals that save money if I subscribe for three years instead of one.

Often, when I get a renewal notice I can't recall whether I paid for three years or only one. And I certainly haven't been able to read the publisher's computer code to find out.

Now, I enter the name of each magazine into my computer's memory with the beginning and ending dates of the subscription and the publisher's computerized account number. I can refer to it if I ever have to (heaven forbid) write to him.

Having dug into several 220 volt cables (I do a lot of digging) that run underground from my house to the work shed and sprinkler system's pump, I have carefully noted their location and placed this information on cassette tape for reference the next time I begin an outside

excavation job.

If you ever contemplate selling your home, you will want to know (for tax purposes) the capital improvements you have made to the property. In anticipation of such an eventuality, I have entered pertinent information on tape reminding me of a driveway constructed last year, and a new 30-year roof installed in 1975.

Ever have a combination padlock whose "open sesame" numbers you had forgotten? Well, I have several. Fortunately, I had written their combinations on a slip of paper which I found while gathering other information for entry into the computer's memory bank. I recorded the combinations of those locks on tape too. If I had needed the locks, believe me, there's no way that I would have found the combinations!

Another bit of information I got into the computer was the procedure used to reset my digital watch. It's a good thing, because now I can't find the manufacturer's instruction sheet.

Personal Items

A project I am working on right now is to enter my entire list of correspondents into memory. In addition to names, addresses and telephone numbers, I want to list the first names and birthdays for all members of each family.

My wife has this thing about sending birthday and anniversary cards to almost everyone we know. So, I'll want to use a program which will allow printout of, for example, the names and addresses of all correspondents whose birthdays occur in June.

She also wants a list keyed to identify the Christmas presents we gave each member of our family last year to avoid duplication next year, and a special Christmas card mailing list.

Designing the program to search my correspondents file is not difficult. Unless several of you beat me to it, I'll submit such a program to *Kilobaud*.

The personal file also contains details of my eyeglass prescription, policy numbers, coverage amounts, contract location, agents' names and addresses for life insurance policies, identification numbers of checking and savings accounts, location of property deeds, and social security numbers.

Automobiles — too Much to Remember

Second only to the house, my cars represent major investments about which I need to retain much information. My computer can help me keep my car records straight.

Second only to the house, my cars represent major investments about which I need to retain much information.

As a start, I recorded serial numbers, body numbers, tag numbers, annual inspection dates, title numbers and the location of the titles, registration certificate numbers, car body paint color numbers (for touch-up purposes) and car insurance policy details.

In addition, I entered into memory the dates I replaced batteries and tires, information on where and when I bought them, invoice numbers of bills of sale, etc.

I maintain my Volkswagen myself and retune its engine every six months or so. It's amazing how soon I forget plug gap settings, point clearance (dwell angles), valve clearances, compression measurements, valve adjustment sequence, carburetor adjustments and recommended engine idle rpm.

Each time, I have to spend an hour or more referring to the maintenance manual to refresh my memory on procedures, dimensions and sequence.

Since I placed the tune-up procedure in my car file cassette, the computer prints out the entire operation on my Teletype machine so that I can take it to the carport in hard copy form. If that copy gets lost, I'll simply have the computer run off another one.

Computer Support for My Hobby

The computer does a lot of remembering for me where my other hobbies — amateur and CB radio — are concerned.

Over the years I have accumulated quite a few pieces of electronic equipment (transmitters, receivers, transceivers, test equipment and tools). With so many break-ins occurring these days, the question is, How can I protect this equipment?

As a partial solution I recorded the manufacturer's serial number of each major piece of equipment and etched my driver's card number (I'm told that social security numbers are more difficult to trace) inside the cabinet of each component. I can now tell police exactly where to look for my identifier even if thieves remove the etched markings on the outside of the equipment.

Police can use the specific identification data provided by my computer to trace ownership back to me. I'm also a dreamer, since if anything gets taken it will be the computer, right? In that case, I'll take the tape file to another SWTPC 6800 owner for reading.

I also recorded (for insurance purposes) the purchase date and price paid for each piece of electronic equipment, TV sets, hi-fi equipment and several other high value items.

I also keep the callsigns, handles, names, addresses and telephone numbers of members of my two meter repeater association in the computer's file. This list is in front of me when the net meets each week and I'm never embarrassed by not knowing the "handle" used by each club member.

Since the Federal Communications Commission has allocated certain segments of various ham bands to those with particular license classifications, my computer contains a listing of those frequencies on which single sideband operation is prohibited. This constant reminder keeps me legal with the FCC.

A Word about Efficiency

Most of the uses described here require nothing more of a computer system than to record information on a cassette. In many cases, I did not even bother to use the limited 2102 memory ICs in the SWTPC 6800. All I did was type file information on the terminal's keyboard and record it (in binary form) on magnetic tape.

If you type as slowly as I do, you will understand that this system is very inefficient. It uses lots of tape since the recorder is pulling it past the recording head while I am hunting for the next letter key to press.

To compress the information, it is necessary to write a program, enter information into the computer's memory, and then transfer it to the tape recorder at high speed.

Besides being able to enter a large amount of data on a relatively small segment of tape through use of a program, I can use the computer to search and format

the information in special ways.

I mentioned earlier that the address list program would give the names of friends and relatives whose birthdays occur in June. If the program is coded correctly, I can call for a listing of those to whom I sent Christmas cards and gifts last year, and a listing of the gifts.

Furthermore, if I am planning a trip and will be passing through Georgia, Kentucky, Missouri, Kansas and Colorado, the computer will print out the names, addresses and telephone numbers of all acquaintances in those states. I can take the printout with me and visit those friends if time permits.

New Program Ideas

Now, with a major portion of memory-aid information on tape, I'm beginning to think in terms of programming the computer to manipulate the information for a particular purpose.

In addition to the address list, I am working on a program to prepare 35 mm slide shows for viewing by specific audiences, and another to aid our weekly trips to the local supermarket.

My interest in having the computer help organize slides for particular groups comes about for two reasons — neither of which is uncommon these days.

First, both of my brothers are divorced and have remarried. I have traditionally chronicled frequent family gatherings on film, and each successive event seems incomplete without a slide program allowing us to re-live some of the "good old days."

I've learned the hard way that such family shows can prove embarrassing, so I plan to number all the slides and key the numbers to specific dates, places, events or family groupings.

Also, if we have friends who are planning to travel and want to preview the places they expect to visit, the computer can assemble a slide program showing London, Paris, Bonn and Rome or a number of other places that they want to visit vicariously.

The computer can certainly help with weekly visits to the food store.

Our buying habits are pretty firmly fixed, and some might even contend that our menus are in somewhat of a rut, but we are content with them. For example, we have spaghetti with tomato and meat sauce every other week (my wife makes a delicious meat sauce!). So the things we buy each week fall more or less into a pattern.

I plan to go to our supermarket and list the items that we usually buy — in the order we pass them on the shelves.

I'll end up with a list of products and their prices arranged in the order we see them as we push our grocery cart about the store. Then, I'll give each item a sequential number and enter the list through computer memory onto cassette tape.

To develop a master shopping list, I'll have only to command the computer to print out its supermarket listing. From that we can check the items needed each week and proceed about the store picking them up in order of appearance on the list (see Table 1). Or, I can enter the numbers corresponding to the items we want to buy, using the master list as an aid. The computer will then be programmed to print out a list of those products we select from the master list, show the aisle where the products are displayed, their unit prices, and the total for all items purchased.

If we can resist impulse purchases, we will have a good estimate of our bill before we reach the checkout counter.

To compensate for changes in unit prices of items the computer can ask for an inflation factor that it can use to add — say six per cent — to the items bought before it prints out the total cost.

I don't have my computer programmed yet to help sort 35 mm slides or solve shopping list problems, but I'm working on them now. There is nothing complicated about either program, so you might want to write them yourself.

I mention both program concepts to give you a better idea of the sort of task a home computer can help with.

SHOPPING LIST DATE: May 27

No.	Item	Aisle	Price
3	peaches,can	1	.75
7	milk,gal.	1	1.79
8	eggs, doz.	1	.89
10	lunch meat	2	.69
14	ground beef	2	1.59
18	tomatoes,can	3	.73
19	tomato sauce,can	3	.31
20	tomato paste,can	3	.51
37	spaghetti	10	.43
39	olive oil	10	.78
57	garlic	18	.25
57	lettuce	18	.39
64	onions	18	.69
	sub-total		$ 9.81
	inflation factor? 6%		.59
	total		10.40

Table 1. A sample grocery list printout made from the computer's master tabulation. Each item shown is placed in the order that you pass it on the shelves of your favorite supermarket. Since unit prices can change, the total bill is only an approximation.

The Care and Feeding of a Computer

The success that you will enjoy in having your computer keep record files for you will depend on your ability to keep it supplied with good, current information. The computer will be no better than your memory if you fail to update its data.

I keep a file basket near my computer in which I place data for entry into particular memory files during the next revision job.

For example, receipts for a new battery or tire will go into the basket until I use them to update my car file tape.

Scraps of paper containing any new addresses I get from my correspondents go into the basket as a reminder to make the required change in my address file.

After the entries are made, the papers are kept in a folder since it's sometimes easier to retrieve a sales slip to make an exchange than to run a cassette to get the sales data.

The updating process requires that you have at least two cassettes for each file. Always keep the most recent of your two recordings as a backup to the one that you erase and rewrite with current information. And before you erase the older cassette, play back the other one to see that it contains valid data. Until you are familiar with your computer's operation, you'll find it rather easy to make a mistake as you dump a program from memory to cassette. So check. The cliche is very apt: "Better to be safe than sorry."

But What Can It Do?

The next time you hear someone ask what a personal computer can do, remember some of these uses.

If you can't think of uses for a computer other than playing games, you really do need one to help you with your memory problem.

It's a more practical device to have around your home than you might have thought — or remembered. ■

Build The $35 Modem

... uses the MC14412 and a UART

Ron Lange
4128 West Barbara Ave.
Phoenix AZ 85021

The idea of being able to call up a friend's computer over the phone and exchange programs, language processors, messages and whatever is something that fires up the imagination (i.e., it sounds like a lot of fun!). Ron is another one of the many professional hardware types within our ranks who is "making his contribution" by sharing a modem he designed with us. He's using his for communicating with a timeshare system. I'd like to see an article describing the adventures and misadventures of two computers using a modem such as Ron's for communicating with each other. — John.

Modem chips are now available that make it possible to construct a good modem inexpensively. These circuits have a unique advantage: By using a crystal oscillator, a modem can be built with no timing adjustments necessary.

The modem described here was built in as part of my TV terminal to use on a time-sharing system. Commercially built modems and even modem kits were too expensive for my budget. The advertisement for the Motorola MC14412 modem chip in the hobbyist magazines for less than $22.00 (Tri-Tek Glendale, AZ) caught my attention. The main problem was that very little information was available for building a complete modem with this chip.

The do-it-yourself approach appeared to have many problems, but it actually turned out to be an easy project. After buying a crystal and some op amps, and adding a transformer and some resistors from the junk box, the modem was built for less than $35. Since it was being built as part of the terminal, the standard RS-232 interface was eliminated, and the modem connected directly to a UART for a parallel interface. A threshold (carrier) detect was not included.

How It Works

Digital transmission uses a Frequency Shift Keying (FSK) modulation scheme. Two frequencies 200 Hz apart are used where a logical 1 (MARK) is the higher frequency and a logical 0 (SPACE) is the lower frequency of a pair. Two pairs of these frequencies are used for two-way communications which is called full duplex. Full duplex is usually limited to 300 baud.

The lower pair of frequencies is usually used for transmission by a terminal while the higher pair is used for receiving. A modem operating in this mode is called an "originate mode" device since a terminal is usually used to originate the call to a computer. "Answer mode" devices transmit on the higher pair and receive on the lower pair frequencies (see Table 1).

During full-duplex operation, both devices are transmitting at the same time. While no data is being transmitted, the modem will be sending a continuous MARK frequency (logic 1). Character transmission commences with a start bit, which is the first change from a MARK to a SPACE, followed by the character where a MARK represents the logical 1 and a SPACE is a 0. The character can be followed by a parity bit, then will be finished with a stop bit, which returns the sequence to a MARK.

The MC14412 modem chip (see schematic, Fig. 1) contains the complete FSK modulator and demodulator capable of speeds up to 600 baud. A 1 MHz crystal oscillator provides a stable frequency reference. The frequency is divided down to provide a digital synthesized sine wave output from the modulator. The oscillator frequency is also divided down and used to demodulate the received carrier.

Several user options are available on the modem chip which can be hard wired or

	Originate	Answer
MARK	1270	2225
SPACE	1070	2025

Table 1. Transmit frequency.

made switch selectable. When SELF TEST = 1 (pin 2) the demodulator is switched to the modulator frequency and demodulates the transmitted FSK signal. A switch should be used for this function. When set to self-test, a character typed out will appear again back on the screen.

The Receive Data Rate (pin 6) selects optimum signal to noise performance of the demodulator. Pin 6 should be wired to +5 V for 0 to 300 bps. Pin 6 should be grounded if 0 to 600 bps is desired.

The originate mode is selected by setting MODE = 1 (pin 10). This should be switched to +5 V if the modem is to be used as a terminal. MODE = 0 is for the answer mode.

The transmit carrier is enabled when TX enable = 1 (pin 12). If TX enable = 0, no output tone can be transmitted. This can be wired to +5 V since the modem output is switched after a call is made. Some terminal modems have a carrier detector circuit to drive the TX enable high after a carrier is detected from the answering device. If TTL chips are used to drive the modem, TTLD (pin 15) should be wired to ground. TTLD = 1 is used if CMOS chips are used.

The transmit data output from the modem must be buffered. The buffered output is mixed with the telephone input and is across the duplexer. The purpose of the duplexer is to cancel out or reduce the transmit signal to the filter while amplifying the received signal. A 3-stage filter is used to further amplify the received signal while rejecting unwanted noise and harmonics. The filter is a design which appears in the *TV Cookbook* and the *Motorola Application Notes*. Since this is an originate modem, the receive filter will pass the higher pair of frequencies. If an answer modem is needed, the second filter shown should be used. If desired, the modem can be built to operate either mode by switch selection.

This modem is designed to match the telephone 600 Ohm impedance through a 1:1 transformer or a data-set coupler. A transformer or coupler is necessary to isolate modem and telephone dc voltages. Most telephone companies require that attachments to their lines be made through a coupler provided by them which they install and rent on a monthly basis. If a telephone supplied coupler is used, remove the transformer and switch from the circuit.

The modem can be modified to an accoustical coupled type modem by eliminating the duplexer and driving a small speaker with the output buffer and using a mike or pickup coil as input into the filter. See the Penneywhistle (*Popular Electronics*, March 1976) for a description of building the accoustical coupling.

Construction Notes

This modem was built up breadboard fashion on a scrap circuit board and as such presented no problems. It

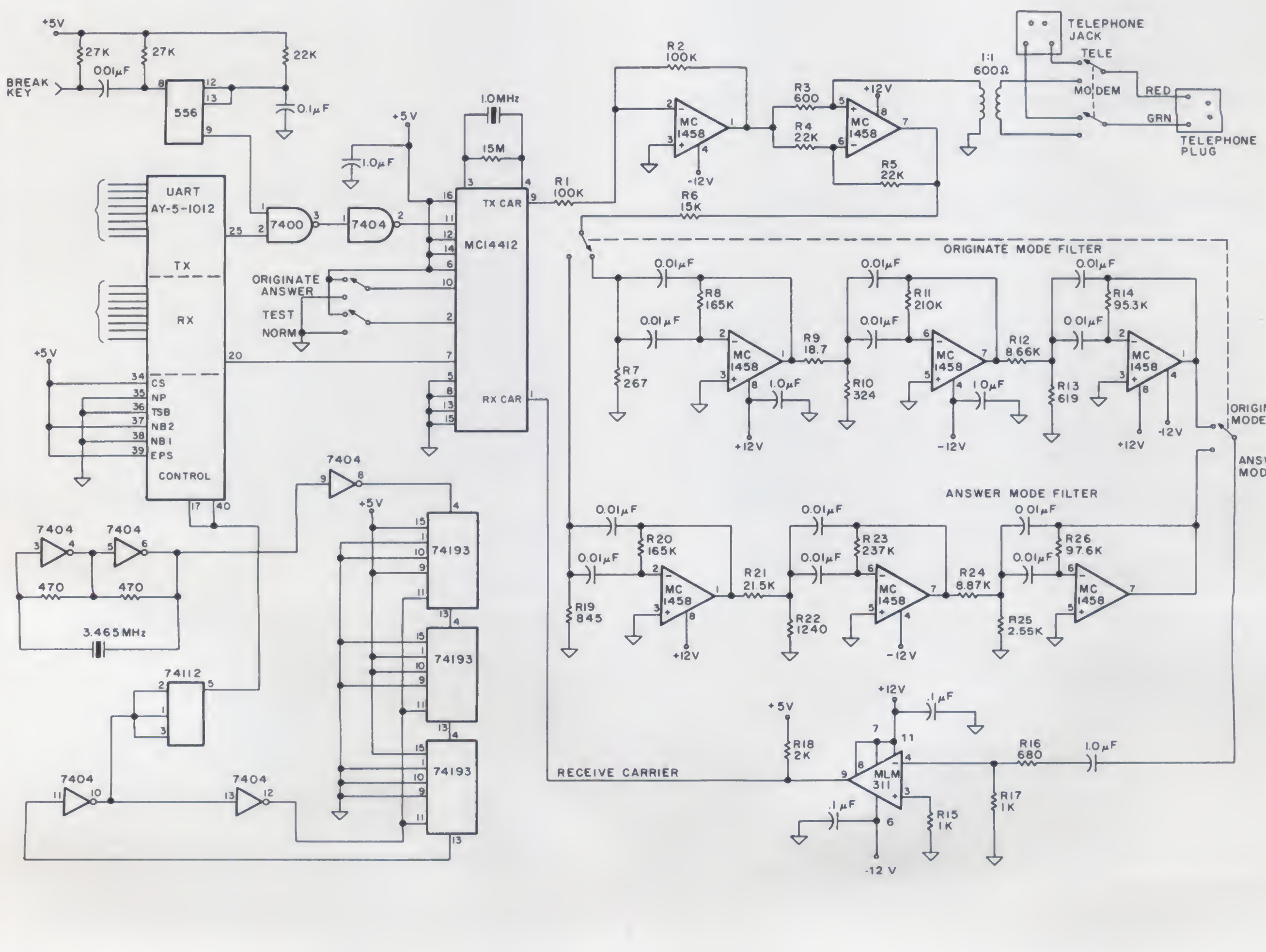

Fig. 1.

would be nice to build it on a printed circuit board, but it is not necessary. The important thing is all voltages should be adequately decoupled with 1.0 uF capacitors at the IC locations. Some of the resistors called for are non-standard values or hard to find. Most of these were made up with series combinations.

Testing Your Modem

Before using the modem on the telephone, the modem and terminal interface can be checked out by setting the self-test switch in the test position. This causes the demodulator to change to the transmit frequency pair. The transmitter data will then be looped back and demodulated. Any character typed out should then appear back at the receive bus of the UART and printed on the display. No timing adjustments are necessary.

The output of the transformer should be checked for an output signal of -0.15 dbm (0.39 vp-p). If an output adjustment is needed, R2 can be changed to a 500k pot. (This change also will be necessary if an accoustical coupler is used.)

If any measurements are made across the telephone lines be sure an ungrounded meter is used. If your meter does not have an output jack, use a 0.1 uF capacitor in series with one of the meter leads to eliminate the dc voltage across the phone lines. Do not make any measurements across the telephone lines unless you have dialed and have someone on the other end of the line.

Interfacing and Operation

The UART is shown in the diagram with the modem. Other methods may be used to interface between the modem and user equipment. The timing and character code are established by the UART. Remember, the modem only passes data through, and serves only to modulate or demodulate the data stream, and timing and code must come from the user device. This terminal is set for 300 baud, using a 7 bit (ASCII) character with "even parity", one start and one stop bit. These requirements vary on different systems and if the exact configuration is unknown, they can be made switch selectable. Some terminals have switch selection for "even/odd parity" and "parity/no parity." These functions are selected on the control section of the UART.

One signal frequently used, which is not part of the character code is the "break" or "interrupt" signal. The break is used to interrupt the computer during a long transmission or computation. This is transmitted as a 250 ms SPACE signal which can be "ORed" in with the UART data. The clock frequency for the UART must be 16x the baud rate or 4800 Hz for 300 baud transmission. This frequency was obtained by dividing a 3.465 MHz crystal by 722. Although 3.465 MHz is not an exact multiple of 4800 Hz, it was the closest frequency that could be found in the junk box, and comes within a couple of cycles of 4800 Hz.

This modem circuit has been in operation now for several months with no problems. Operation is very simple, after dialing into the computer and hearing the answer tone, throw the switch to the modem position. Remember to return the switch to the telephone position to hang up. ■

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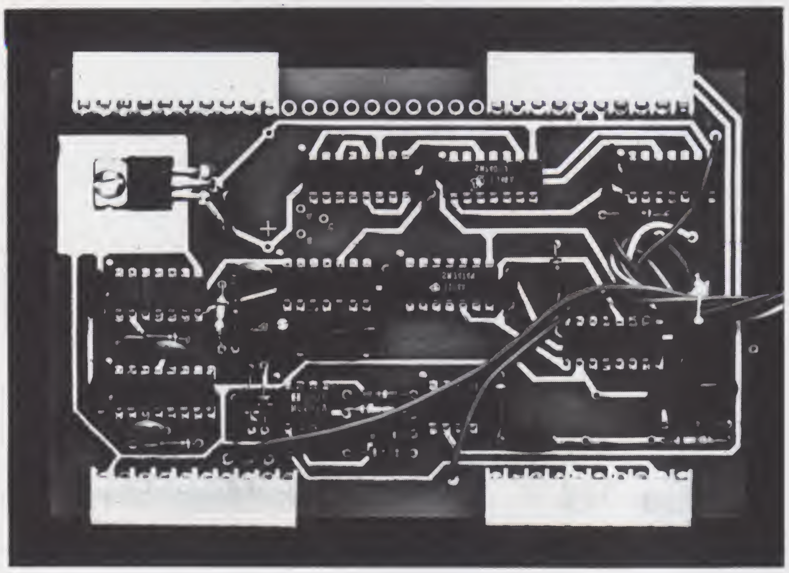

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FUNCTION:	Record and play digital data to computer using an ordinary cassette tape recorder.	CAPACITY:	C-60 100K Bytes/tape C-30 50K Bytes/tape
CONTROL:	One switch SPDT-Centeroff	DATA TERMINAL:	Any RS232 or loop current device compatible with the 6800 system.
INDICATORS:	One L.E.D. indicating the logic "O" condition	PHYSICAL SIZE:	SWTPC 6800 I/O card (3" x 5")
DATA RATE:	300 Baud (30 ASCII Char per sec.) 2400 Baud (240 ASCII Char per sec.)	AUDIO LEVEL:	4 Ohm external speaker level at 100 mV
ENCODING METHOD:	'Kansas City' Biphase Standard; Serial Asyncronous, using one or two stop bits, non-saturating, self clocking, syncronous frequency shift. The encoding method is also called the Biphase-M and Manchester code.	POWER:	+12, -12, 8V regulated on ACI-33

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J. G. Letwin
Software Engineer
Heath Company

Another Look at Benchmark Programs

... in the eyes of the beholder!

*Gordon wrote this article in response to Tom Rugg and Phil Feldman's articles on "BASIC Timing Comparisons" (*Kilobaud*, issues 6 and 10). He has some interesting points both for and against benchmarks ... and what they mean. — John.*

A major concern for most prospective purchasers of a computer system, be it a large professional system or a small hobby system, is speed. In other words, "How long will this system take to do my work?" or conversely, "Is this system fast enough to do my work?" In both questions the critical phrase is "my work." A good speed comparison or "benchmark" is one that compares the various systems you are considering while those systems are running the programs that you will be running. This is important because different programs make different demands on a computer system, and different systems have different strengths and weaknesses. There are two general approaches to the task of benchmarking: 1. Time your existing programs on a system; or 2. Time the speed with which the system performs various operations, and then compute your program's execution time.

For a company considering the purchase of a large system, the first technique works well. Benchmarking consists of gathering up several typical (and time-consuming) programs and making a tour of manufacturers' installations, running at each one. This gives that

Photo 1. The timing setup. Includes an H8 computer, an H9 CRT terminal and a GB-1201 electronic stopwatch.

company just what it wants: an accurate indication of how fast its work is going to go on the new machine. Unfortunately, the average hobbyist cannot afford the plane fare such an approach entails. In fact, he may not have any existing programs to try, since this will very likely be his first system.

As you might guess, this means most hobbyists must make do with the second approach: timing the machine's operation speed. For assembly language programmers, this usually means comparing the instruction sets of the machines and examining the CPU cycle times. However, for the scope of this article we will discuss the timing not of CPU instructions, but of BASIC operations. This is done because currently most user-written software is written in BASIC. The principle used in obtaining these timings is simple:

- Time the processor performing a simple control loop;
- Time the processor on the same loop, with the operation added;
- Compute the difference, and divide by the loop count.

An important fact to keep in mind when doing this is that the timing differences between the two loops represent all the extra actions you may be requiring from BASIC. Often, this does not consist solely of the desired operation. For example, if we attempt to time the + operation by comparing the timings of two loops (see Example 1), we are actually computing the time required to do five different things:

1. Set up another statement (which was not included in the control loop).
2. Locate the variable A in the symbol table.
3. Decode the two numbers 12 and 20 into internal floating point representation.
4. Perform the addition.
5. Assign the resultant value to A.

Thus, we can see that this simple test has actually measured much more than we desired and, therefore, gives an inaccurate result. In order to obtain the desired timing, the two programs should appear as in Example 2.

In these two programs, the only difference is the +C in line 120. Now we're only timing two things: the time needed to locate variable C and the time needed to perform the addition. Note that variables were used instead of integer constants; the time needed to decode a constant is considerable and may vary widely between BASICs. The time needed to locate a symbol in a small symbol table (only A, B, C and I) is much less, and, therefore, is less disturbing to the results. If constants are used heavily in your application, they should be benchmarked separately.

Tests Run

To demonstrate this technique, we have run timings of 18 different operations:

- Operators +, -, *, / and + (string concatenation).
- Functions SIN, COS, TAN, ATN, SQR, EXP, LOG and LEFT$.
- Simple numeric and string assignment statements.
- A simple FOR loop.
- Referencing a subscripted variable B(1).

These operations were timed on three different systems:

- A Heath H8 (8080A) Extended Benton Harbor BASIC #(10.01.00.).
- A Heath H11 (LSI-11) (Heath BASIC-11).
- A Heath H11 (LSI-11) with EIS/FIS (Heath FIS BASIC-11).

```
100 FOR I=1 TO 1000
110 NEXT I
```

```
100 FOR I=1 TO 1000
105 A=12+20
110 NEXT I
```

Example 1.

```
100 B=1 : C=2
110 FOR I=1 TO 1000
120 A=B
130 NEXT I
```

```
100 B=1 : C=2
110 FOR I=1 TO 1000
120 A=B+C
130 NEXT I
```

Example 2.

Photo 2. The H11 system. Pictured in front is the Extended Instruction Set / Floating point Instruction Set (EIS/FIS) chip. This installs directly into a socket provided on the KD11F CPU board.

The Heath H8 is a new 8-bit computer, based upon the 8080A microprocessor, running with a clock of 2.048 MHz. Its intelligent front panel provides real-time monitoring of memory and registers. The extended BASIC used for these tests contains many built-in functions and commands to allow control of the front panel displays and keypad, however support of the full panel system requires a CPU overhead of about 11 percent. For the purposes of these benchmarks the front panel system was turned off via a BASIC statement of the form: CNTRL 4,0. This feature is available in Extended Benton Harbor BASIC so that compute-bound programs need not be slowed; yet when necessary, they can reenable the panel for any desired purpose (via the CNTRL statement).

The Heath H11 is a 16-bit computer incorporating the DEC LSI-11 processor, which is compatible with the DEC PDP 11/40. The EIS/FIS mentioned above refers to "Extended Instruction Set, Floating point Instruction Set." This is contained in an optional 40-pin chip which plugs into the LSI-11 board, giving the processor both fixed and floating point arithmetic instructions (add, subtract, multiply and divide) as well as extended 16- and 32-bit shift instructions.

The timings were made using the control and timing loop technique described above. By making a comparison between two similar loops, almost all the system's fixed overhead cancels, leaving an accurate timing. Thirteen numeric operators were timed, using as a control loop:

```
100 B=1.1 : C=1.5
110 FOR I=1 TO 2000
120 A=B
130 NEXT I
```

The tests are shown in Example 3a.

Note that test N14 consists of removing the "A=B," thus providing a negative timing, showing the time required to process an assignment statement. (This time is shown as positive in the tables.)

Three string operators were timed, using the control loop in Example 3b. The operations timed were:

```
S1: 120 A$=B$+C$
S2: 120 A$=LEFT$(B$,1)
S3: 120
```

As before, test S3 is actually measuring the time to perform the string assignment statement.

Finally, an array reference was timed (A1), using Example 4 as control and test.

```
N1: 120 A=B+C
N2: 120 A=B-C
N3: 120 A=B*C
N4: 120 A=B/C
N5: 120 A=B↑C
N6: 120 A=SIN(B)
N7: 120 A=COS(B)
N8: 120 A=TAN(B)
N9: 120 A=ATN(B)
N10: 120 A=LOG(B)
N11: 120 A=SQR(B)
N12: 120 A=EXP(B)
N13: 120 FOR J=1 TO 5 : NEXT J
N14: 120
```

Example 3a.

```
100 B$="STRINGB" : C$=STRINGC"
110 FOR I=1 TO 2000
120 A$=B$
130 NEXT I
```

Example 3b.

```
100 DIM B(500)          100 DIM B(500)
110 FOR I=1 TO 500      120 FOR I=1 TO 500
120 A=B                 120 A=B(I)
130 NEXT I              130 NEXT I
```

Example 4.

How the Tests Were Run

These tests were run on the new Heath systems. For each system, the procedure was the same: the programs were entered from the keyboard, and an additional line

```
400 PRINT CHR(7)
```

was added. This causes an ASCII BELL code to be sent to the terminal upon completion of the loop.

The timing was done with the aid of a Heath GB-1201 digital stopwatch. The stopwatch was started when carriage return was struck, and was stopped when the terminal bell was sounded. Both the control and timing loops were clocked in an identical manner, so that the fixed overhead of readying the program for execution and processing the PRINT statement canceled. Each timing was done three times, and the results averaged. Since the stopwatch was triggered by hand, the 1/100th-second digit was ignored; the times were taken in seconds and tenths. The results obtained are quoted to two places only; further places, even if accurate, are meaningless.

Discussion of Results

As can be immediately seen from the timings (Table 1), there is considerable difference between the systems. It is immediately evident that these systems represent three different performance groups: 1. the 16-bit system with floating point hardware, 2. the 16-bit system without floating point hardware, and 3. the 8-bit system (without floating point hardware).

It comes as no surprise that a 16-bit machine will perform considerably better than those used in the H11. This brings us back to the original statement of this article: A system's speed is critically dependent upon your program; a program that heavily uses transcendental functions would show a different performance ratio

Pgm	test	H8[1]	H11	H11/FIS
N1	+	2.3	1.0	.6
N2	-	2.5	1.1	.6
N3	*	3.8	1.9	.6
N4	/	4.9	2.0	.6
N5	↑	35.	23.	5.3
N6	SIN	13.	14.	2.8
N7	COS	13.	16.	4.0
N8	TAN	24.	32.[2]	7.4[2]
N9	ATN	21.	19.	3.3
N10	LOG	19.	14.	3.0
N11	SQR	13.	7.2	1.9
N12	EXP	15.	13.	3.0
N13	5*FOR	23.	7.5	7.5
N14	A=B	3.0	.5	.5
S1	B$+C$	4.5	2.0	2.0
S2	LEFT$(	5.8	1.7	1.7
S3	A$=B$	4.6	1.0	1.0
A1	B(I)	2.6	.5	.5

[1]all H8 timings with real time clock off (CNTRL 4,0).
[2]computed by SIN(X)/COS(X).

Table 1. Benchmark results. All operation times in milliseconds.

time faster than an 8-bit one. In fact, the H11 system appears to run roughly twice as fast as its 8-bit competitors. Likewise, it is also to be expected that the addition of floating point hardware will greatly speed up the arithmetic and transcendental functions. As can be seen for the identical timings of the +, -, * and / operators, the actual arithmetic is now an insignificant part of the operation's timing.

The Heath H8 computer, an 8080A machine, performed considerably slower than did the H11 systems, for obvious reasons. However, a brief study of the timings will show that the H8 is by no means a slouch, but provides performance levels that were obtained only by midsized computers just five years ago. It is also curious to note that the H8 system computes some trigonometric functions faster than the non-FIS H-11. This indicates that the algorithms used in the H8 BASIC between the H8 and H11 than would a program consisting mostly of FOR loops.

Conclusions

An important question, and one that has so far been overlooked in the hobby literature, is, "What does this all mean?" For some insight, we should classify the various machines tested into performance groups. Machines that show a performance ratio of less than 2:1 are quite similar in performance, and belong in the same performance group.

The H11 system is obviously a high-performance system and represents the two highest performance groups. BASIC programmers with large and/or slow programs may require its capacity. Engineers, physicists, and the like may require its impressive floating point capacity for large computational problems.

The 8080A system performs well in the midrange. It is well suited for most home

and hobby applications, providing good general performance at an economical price. Also note that a machine in its performance class can do computations as complex as those in any other class; it just takes longer. Users who do lengthy calculations may be satisfied with the wait.

It is interesting to note that these same benchmark timings were made for an ALTAIR 8800 running Extended Basic 4.1, which showed the Mits system to execute control statements (such as FOR loops) slightly faster than the Heath H8, but the H8 system executes transcendental functions somewhat faster than the Mits 8800. So, we must answer the question, "which is faster?" by saying, "neither!" They both belong in the same performance class. Some programs will run faster on one, some will run faster on the other. Their computational performances are too close for comparison; a shopper will have to make his decision based on other criteria.

The important thing to remember here is to not take the timings too seriously. They are valuable in that they give an indication of the general capacity of the system, but they are not useful for comparing two machines in the same general performance class. Most BASIC programs are rather I/O bound so that minor variations in speed do not matter. For the programmer whose job requires such a large amount of time that BASIC speeds are important, then any BASIC within that performance class will be too slow. The proper solution is to move to a faster class of machine, or perhaps to get away from BASIC altogether. BASIC was originally designed to teach programming concepts to beginners, and it serves that purpose very well. It was not designed for most of the work a typical hobby system is asked to do, and usually does poorly when forced into those applications. It has been said with considerable justification that the words "BASIC" and "speed" are contradictory.

Another possible pitfall to avoid is becoming engrossed in raw numerical speed, and ignoring your purpose in buying a machine. For example, those with a sophisticated interest in software may prefer the H11 system, not because it is faster, but because of its powerful architecture, which supports sophisticated structures and techniques that are not feasible on the 8080 or 6800 processor.

To summarize, benchmark timings are only useful in getting a general idea as to a system's capabilities. The decision between machines in the same general category must be made on the basis of general system factors: availability of other products and languages, cost of the machine, stability of the product, etc. Paying too much attention to speed variations simply confuses the issue, since each system does better at different types of problems. Likewise, system A may be very slow at a certain operation, but it may contain features that allow you to get the job done easier without even using that operation! Detailed benchmarks are useful only to commercial shops that run very large and unvarying jobs, and then only when run on those specific jobs.

A general rule of thumb is that unless one machine runs several times faster than another, you should base your decision on the usefulness of the system, not just on simple loop timings. Unfortunately, such decisions are hard to make and tend to be subjective, whereas it is very easy to wield a stopwatch and make detailed measurements of meaningless speed variations. ■

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Son of Submarine Game

. . . an alternative to chess?

Pete Stark's SR-52 game program "Submarine" originally appeared in issue #2 of Kilobaud *and has since become one of the most popular games played on that calculator. Ed and John call their version "Son of Submarine" and they have some modifications which make the game even better. Enjoy. — John.*

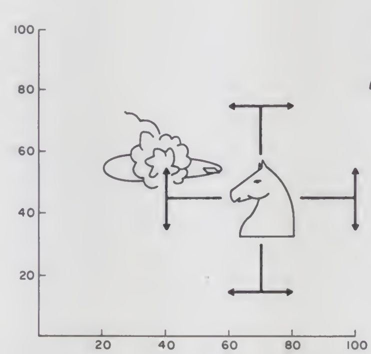


Fig. 1. Game layout.

The game "Submarine" in issue #2 of *Kilobaud* by Peter Stark was most interesting, and I lost no time in entering the program into my SR-52 to try it out. However, after playing the game awhile I felt that something was missing. There wasn't the same enjoyment as playing the lunar landing game from Texas Instruments' (TI) program book. So I asked my coauthor to try the game and he came to somewhat the same conclusion. First, the game was very cleverly conceived. But after you get within five miles of the sub (which can be accomplished quickly by triangulation), the odds are 1 in 100 of selecting the proper locations on the next try since the sub will have moved randomly to a new location somewhere within a 100 square mile area. We felt that this game needed a small addition to allow the player to use logic in choosing his shot.

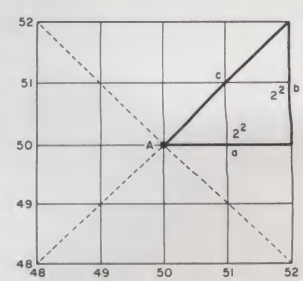
After examining the flowchart and trying a few variations, we discovered a simple addition which would still save the random motion realism of a submarine under attack but would allow the player to use his knowledge of mathematics and logical thinking ability to make the game more interesting. After all, one of the most interesting aspects of computed games is the satisfaction of being able to match logical wits with the computer and possibly get a step up and win.

Now with the changes made to the original submarine game the following scenario applies.

An enemy submarine has been spotted near one of your ports, its exact location unknown. To destroy it, place a 100 x 100 grid of graph paper over a map of the suspected area as shown in Fig. 1, and drop depth charges at specified points, using the X and Y coordinates to keep track of their location. *Each time you fire, the submarine moves to a new location. Sonar and other classified equipment then pick up an echo from the submarine and tell you the distance to its new position.*[1] Of course, as soon as you start firing, the submarine starts to zigzag in an effort to escape. The sub can go anywhere in the square as well as up or to the right of it, though it cannot go left or down into negative X and Y coordinates — since this would bring it too close to shore. The submarine can be put out of commission only by a direct hit (signalled by flashing lights of the calculator). If you miss by a distance of five or less, you only inflict minor damage; the submarine can tolerate up to five minor hits, but on the fifth minor hit it puts on a great burst of speed to get to a new location so repairs can be made. To play the game, proceed as follows:

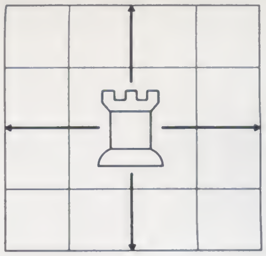
1. Push the C button to start the game.
2. Enter the X coordinate for your depth charge; push A.
3. Enter the Y coordinate for your depth charge; push B.
4. If you hit the sub, the display will flash, otherwise

[1] The original submarine game provided the distance by which the players shot missed the submarine at its old location. It is the providing of the distance to the new submarine position that is the basis for Son of Submarine Game.

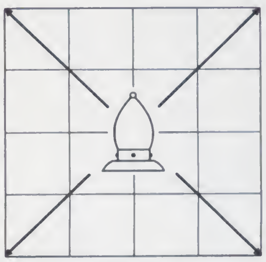


A = Position of last shot.
Display of distance = 2.83
$a^2 + b^2 = c^2$
$a^2 + b^2 = 8 = 2.83^2$
$c = 2.83$

Fig. 2.



The Castle may move any open distance along a vertical or horizontal row of squares (on a standard checkerboard).



The Bishop may move any open distance along a diagonal.

The Knight's move is an L shaped move of two up and one over in any one of the four basic (up, down, left, right) directions, allowing eight possible locations to be reached.

Fig. 3.

DISTANCE FROM SUB	CHESS PIECE	SPACES MOVED	PROBABILITY OF SUCCESS
1.00	CASTLE	ONE	25%
1.41	BISHOP	ONE	25%
2.00	CASTLE	TWO	25%
2.24	KNIGHT	TWO & ONE	12 1/2%
2.83	BISHOP	TWO	25%
3.00	CASTLE	THREE	25%
3.16	MODIFIED KNIGHT	THREE & ONE	12 1/2%
3.61	MODIFIED KNIGHT	THREE & TWO	12 1/2%
4.24	BISHOP	THREE	25%
4.00	CASTLE	FOUR	25%
4.12	MODIFIED KNIGHT	FOUR & ONE	12 1/2%
4.47	MODIFIED KNIGHT	FOUR & TWO	12 1/2%
5.00	CASTLE & MODIFIED KNIGHT	FIVE OR FOUR & THREE	8 1/3%

Table 1.

In order to extend the chess move approach up to a displayed distance of five (the limit of the minor hit counter), it was necessary to define a move which we call the modified knight move (not allowed in the standard game of chess). The chess movements and corresponding display distances are provided in Table 1.

Let's see how these movements would look on a 100 x 100 grid. This will give us the information needed to apply these moves to obtain the best probability of tracking down the submarine.

Consider that the starting position of our move on the 100 x 100 grid is X = 50 and Y = 50 (50, 50). See Fig. 4.

Now the move of a knight is shown by move number 1, that is from (50, 50) to (51, 52) — a distance of $\sqrt{2^2 + 1^2}$. The number 2 move is that of a bishop, that is (50, 50) to (52, 52) — involving a distance of $\sqrt{2^2 + 2^2}$. The move of a castle is shown in move number 3, that is (50, 50) to (52, 50) — a distance of 2.

Now it must be realized that the bishop and the castle could stop at any position from (50, 50) to the end of

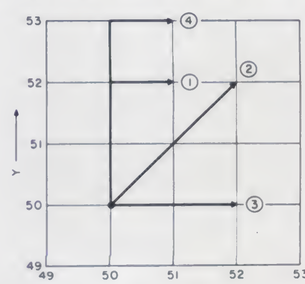
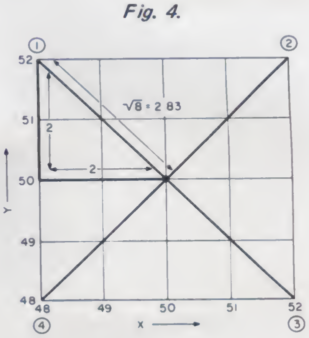


Fig. 4.



distance = $\sqrt{2^2 + 2^2}$ = 2.83

Fig. 5.

the display will indicate the distance to the new sub position. (Note: Under the new scenario you know the distance to the new submarine location instead of the old position.)

The fact that the player may get off a shot at the current submarine position opens up a whole new group of possibilities which enables the player to cut down on the odds against him.

By using the Pythagorean theorem (the square of the hypotenuse of a right triangle is equal to the sum of the squares of the legs, or $c^2=a^2+b^2$) the player may determine all possible locations of the sub corresponding to the displayed distance. Fig. 2 shows the four possible locations (48, 48); (52, 48); (48, 52); (52, 52) for a displayed distance of 2.83 from (50, 50). All possible locations for display distances up to five have been calculated and are provided in Table 1.

An interesting point noted during these calculations is that as one gets close to the sub the moves which provide the greatest probability of success are similar to the movements of pieces in the game of chess. The player need not concern himself with the game of chess in its entirety in order to use this technique, but rather needs only to understand the allowed movements of three of the higher ranking pieces of the game. These pieces and their corresponding movements are shown in Fig. 3.

the grid. For example, a castle move from (50, 50) to (50, 100) is a move of 50 miles on our 100 x 100 mile grid.

Now a move from (50, 50) to (51, 53) — move number 4 — is not a proper move on a chessboard, but is a modified form of the knight's move with the same number of possible moves as that of a knight (eight moves).

Now let's try out this newfound knowledge on the Son of Submarine game (see Fig. 5).

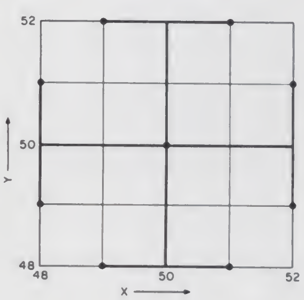
For example, if we have just fired at the location X = 50, Y = 50 (50, 50) and the calculator answers back that we missed by 2.83 miles, there are only four different ways this could happen. That is if the sub is now at (48, 52); (52, 52); (52, 48); (48, 48). These are the only possible combinations that the SR-52 could compute 2.83 or $\sqrt{2^2 + 2^2} = \sqrt{8} = 2.83$. This is the move of a bishop. The possibility of a hit is one out of 4 or 25%.

Refer to Fig. 6. Again we have just fired at location (50, 50). The missed distance is displayed by the computer as 2.24 or $\sqrt{2^2 + 1^2} = \sqrt{5} = 2.24$. There are only eight different ways this could happen. And that is if the submarine is at (49, 52); (51, 52); (52, 51); (52, 49); (51, 48); (49, 48); (48, 49); (48, 51). These are the only possible combinations that give the distance 2.24 miles from (50, 50) and these eight moves are the moves that a knight can make in a chess game.

In the example in Fig. 7 we have just fired at location (50, 50). The missed distance is displayed by the computer as 3 or $\sqrt{3^2 + 0^2} = \sqrt{9} = 3$. There are only four different ways that this could happen, and that is if the submarine is at (50, 53); (53, 50); (50, 47); (47, 50). These are the only combinations that give a three mile distance from (50, 50) and are the moves that a castle can make.

In Fig. 8 we once again consider that we are firing at location (50, 50) and we are given a 3.16 mile distance to the sub by the computer. There are only eight ways that we could be 3.16 miles away from the sub: (49, 53); (51, 53); (53, 51); (53, 49); (51, 47); (49, 47); (47, 49); (47, 51). These are the only combinations that give a 3.16 mile distance. This is a modified knight's move.

Now I think you can see that once we get within five miles of the submarine we can use our knowledge of mathematics to logically deduce the move which will give the best probability of a hit.



(49, 52) (51, 52) (52,51) (52, 49)
(51, 48) (49,48) (48, 49) (48, 51)

Fig. 6.

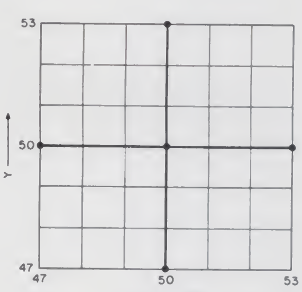


Fig. 7.

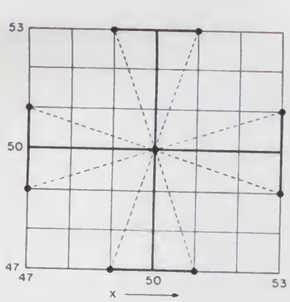


Fig. 8.

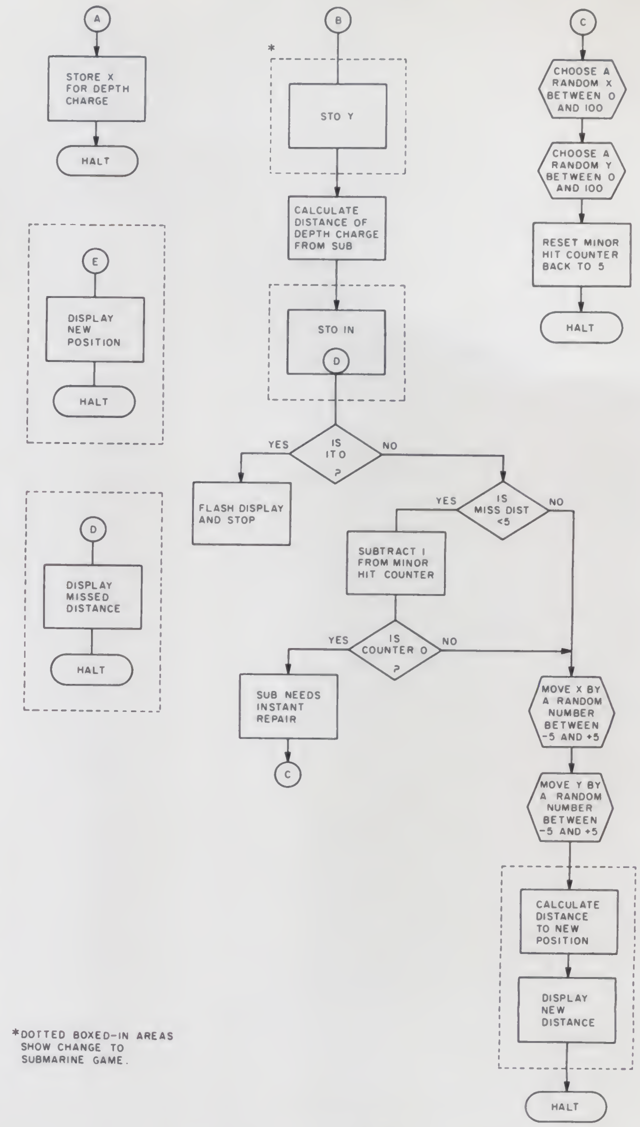


Fig. 9. Son of Submarine game flowchart.

Before trying to use Table 1 to pursue and sink the submarine, let's summarize. Once within a five mile range, before choosing a location to fire on, you will always be able to find the chess move that will give you the greatest probability of success. Just take the distance given by the SR-52 and enter the distance column; when the numbers match, read across to the right for the choice of moves which give the greatest probability of success. For example, 2.83 is found to be a bishop's move. The choices you have for a hit are your original location (X, Y) adjusted for the two-step bishop move.

So, to sum up the game as modified, the player must first get close to the submarine and then based on the distance, make one of the chess moves which will give him the greatest probability of success. If he misses after five near-shot tries (if all attempts were within five miles), the sub will make a quick maneuver to a distant location. He must get close to the sub and try again. For those who are students of probability, you may note the best five-guess combination would be for five 25% chances before the submarine moves, which is 100 $[1-(1-.25)^5]$ = 76%. The probability of success for the original submarine program is 100 $[1-(1-.01)^5]$ = 5%.

Now go out there and get that submarine! ■

Location	Comments	Instructions
000	Label A	Enter X value for depth charge
002	STO 05	Store it in register 5
005	Halt	Stop and wait for Y value
006	Label B	Enter Y value for depth charge
*008	STO 06	
011	- RCL 02	
015	$X^2 \sqrt{X}$ =	
118	X^2	
119	+ (RCL 05 - RCL 01	
028	$X^2 \sqrt{X}$)	
031	X^2 =	Compute distance by which the depth charge missed
033	$\sqrt{X}$	
*034	STO 07	Store missed distance
037	inv if zero =	If zero flash display and stop
040	0 1/X Halt	If not zero . . .
043	Label =	
045	- 5 =	Compare missed distance with 5
048	if pos +	If less than 5 subtract 1 from
050	inv dsz C	Minor hit counter and go to C if counter has reached 0; otherwise continue
053	Label +	
055	subr 1'	Get a small random number . . .
057	sum 01	. . . and move sub sideways
060	subr 1'	Get another small random number
062	sum 02	and move up or down
*065	RCL 06	
*068	- RCL 02	
*072	$X^2 \sqrt{X}$ =	
*075	X^2	Compute new position of
*076	+ (RCL 05 - RCL 01	submarine and store
*085	$X^2 \sqrt{X}$)	
*088	X^2 =	
*090	$\sqrt{X}$	
*091	STO 04	
094	RCL 04	Displayed new sub position
097	Halt	and stop
098	Label C	Reset
100	subr 8'	Get big random number for
102	STO 01	X and Y and move
105	subr 8'	
107	STO 02	
110	5 STO 00	Reset minor hit counter to
114	Halt	and stop
115	Label 1'	Start of subroutine to get a
117	5 +/-	small number between -5
119	+ .10 X	and + 5
124	Label 8'	Start of subroutine to get
126	100 x ((7Y^x9	a big random number between
135	X RCL 03	0 and 100
139	X 5 +/- INV LOG)	
145	- (RCL - .5)	Shuffle number around to
152	FIX 0 DMS INV FIX)	make them seem random
158	STO 03 =	
162	FIX 0 DMS INV FIX	
*167	FIX 2	
169	return	End of both subroutines
*170	Label D	Recall missed distance of last shot
*172	RCL 07	
*175	Halt	
*176	Label E	Recall present distance to
*178	RCL 04	new sub position
*181	Halt	

*New additions to submarine program

Program listing.

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Payroll Program

. . . for small businessmen

This payroll program is designed to make a no-frills computer system a useful tool for the small businessman. By frills I refer to the requirement for extensive scratchpad memory (RAM) and/or permanent disk or tape memory systems, all of which increase the cost of the microcomputer system. This program was developed using the Southwest Technical Products Corp. 6800 Computer, CT-1024 TV Typewriter, and AC-30 Audio Cassette Interface using the Southwest Technical 4K BASIC running in 8K of memory. This system plus an inexpensive TV set and audio cassette recorder make a complete working computer system that can for under $1100 lighten substantially the time and work load of bookkeeping functions.

The payroll program for the 6800 described and listed here will keep track of employees; data such as social security number, marital status, exemptions claimed; and rate of pay for up to 99 employees. Each week the operator enters the paid hours for each employee as his/her number is displayed on the screen. That's it — one very simple entry. At this point, the program takes over and calculates each employee's gross pay, FICA tax, federal income tax and city or state tax, and finally the net pay. Gross pay is figured at straight time for up to 40 hours and at time and one-half for over 40 hours. This is accomplished in less time than it would take to remove the cover from the old adding machine and flick on the power switch.

The complete data base and calculations are then presented to you on the screen, one employee at a time, to allow the writing of paychecks, and also to make ledger entries — if you feel it necessary. After completion of check writing, a file function is made available whereby you can record all data for the week on audio tape for a permanent file, thus eliminating the need for ledgers, and time required to write in them.

DIM What-How?

Before getting into the description of the program, let's take an excursion into BASIC programming techniques for those who are new to this high level language stuff.

Let's take a look at DIM, or dimensioning of variables. First of all, dimension is an elusive term — maybe "define" would be more appropriate. In either case it simply tells the computer how many boxes should be provided in memory to store variables or, more specifically, subscripted variables. Single character alphanumeric variables need not be dimensioned (or specified) in the program. These would be A, B, C or A1, A2 or B1, etc.

When a variable is subscripted, the subscript is put in parenthesis and A_1 is written A(1). This is not to be confused with algebraic expressions that also use parenthesis to separate terms such as (A + B) * (A - C). This can really tax your mind when both uses of parenthesis appear in the same statement — like, Let A(1) = (A(2) + B) * (A(3) - C(4)).

With most BASICs, subscripted variables may be used without a DIM statement inserted in your program and you may be able to run the program without difficulty; but if you get too many, the program will "bomb out" and give you an error message such as Illegal Variable or Memory Full. This is because subscripted variables *must* be dimensioned, and if you didn't do it with a DIM statement your BASIC did it for you when a subscript variable was first encountered. In the SWTP 4K BASIC, for example, an undimensioned subscripted variable is arbitrarily assigned to a 10 x 10 array by BASIC. Now if you had a variable A(N) where N could be numbers 1 through 6 you only need six boxes, but BASIC has allocated 100 boxes for A in 10 rows of 10 columns. If you have a number of variables, say A through X all subscript 1 to 6, you may well run out of memory space. If you tried to subscript beyond ten it would cause an illegal variable error. In order to avoid these errors you must provide a DIM A(6), B(6), C(15), etc., statement at the beginning of your program.

An array can either be one-dimensional or two-dimensional. In DIM A(6) we are establishing a one-dimension array, or six boxes for A(1) to A(6). To make a two-dimension array requires two subscripts separated by a comma, as in E(99,14), to provide an array of 1386 boxes stacked 14 across by 99 high. In the Payroll Program there are 14 variables for each employee; the program can handle 99 employees. However, not all users will have 99 employees, and there is no need to allocate memory space that will not be used. In this case the DIM statement reads E(Z,14); Z is the number of employees listed in the Data Table.

Program Description

In order to run the payroll

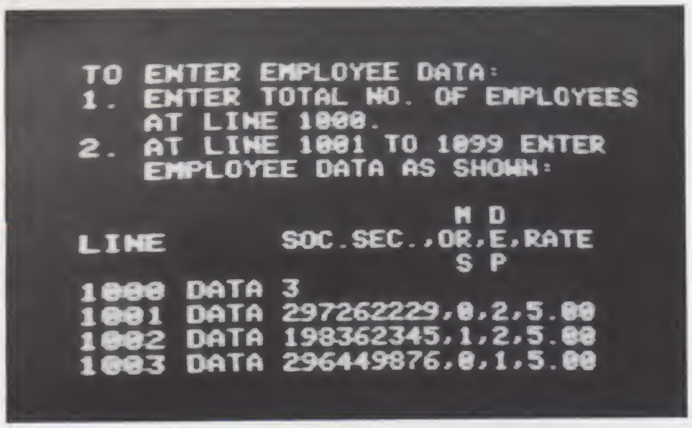

Photo 1. Initial data entry.

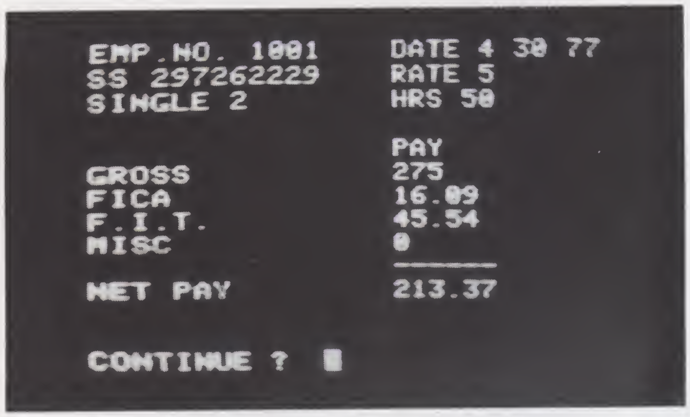

Photo 2. Display of data for check writing portion of program.

program for a 6800 you will need to provide the data for each employee in the DATA statement at lines 1001 to 1099 (Photo 1). Employees are assigned an "Emp. No." corresponding to these program line numbers. The data to be entered in sequence are: social security no., digit 0 if single (including heads of households) or digit 1 if married, number of exemptions claimed and rate of pay. All data are to be entered without spaces, and with commas between groups of data. The data at line 1000 are the total number of employees entered.

A method of making a permanent record of weekly payrolls on audio tape is provided in the program. It is suggested, therefore, that an employee who leaves the company be left in the data base until the end of the year, or at least his payroll number not be reused. If left in, his rate of pay (last data entry) can be changed to 0, which will prevent his number from being displayed on the input of hours worked query. If either rate or hours are 0, that employee will be bypassed in the paycheck writing routine of the program. In all cases the complete employee list will be available and all information printed out to the file record to be recorded on audio tape at the end of program.

The program begins, after home up and erase, at line 110 where the first data for number of employees are read (line 1000), and then the variables are dimensioned in accordance with the number of employees entered. The first operator entry is the pay period ending date, which is entered as month, day and year separated by commas. Then a FOR-NEXT loop reads the employee data and asks for the paid hours by employee number. On completion of this loop we have entered all necessary employee data for calculation of the payroll.

Before calculation proceeds, at the end of hours entry cycle, an opportunity to make corrections to hours entered is provided by "corrections" prompt. If an affirmative response 1 is input, the program will ask for employee number. Upon receipt it will then ask for paid hours, and any change from previous entry can be made. A 0 response to "corrections" prompt will continue the program at the second FOR-NEXT loop between line 430 and 700 to calculate wages and deductions and print the data for each employee, one at a time.

Gross pay is first calculated in lines 440-480, where E(N,6) is gross pay and E(N,4) is rate of pay (from data) and E(N,5) is hours (from input). The first deduction E(N,7) for Social Security F.I.C.A. is made at 1977 rate of 5.85% in line 490. To figure income tax, the marital status of the employee (data entry 2) E(N,2) must be examined at line 520-530 to determine proper tax table. These tables are in subroutines at lines 1100 to 1190 and 1200 to 1290. After selection of appropriate table the first line 1100 or 1200 provides a deduction from gross pay E(N,6) of $14.40 per exemption claimed E(N,3). This figure (G) is then applied to the rest of the table to find the amount of tax to be withheld. For example, a single employee claiming himself as deduction has gross pay of $285.00. In line 1100, $14.40 times 1 would be subtracted to leave a taxable gross of $270.60. This is less than 279, so line 1130 would be used to calculate the tax E(N,8). The tax will be $43.93 plus 26% of excess over $240.00 in accordance with current tax tables in effect (Apr. '77). Our friends in Washington may change these tables and make it necessary to reestablish them at a later date. At any rate, after federal income tax is figured the program continues at line 540 to round off calculations to two decimal places. (See page 40, April 1977 *Kilobaud*.) Thanks, Jack!

The last in this "What we giveth, Uncle taketh away" series is local tax, which may be either city or state income tax. This is provided in line 550 E(N,9) and is set to 0 in this program as there are no local taxes here in Wyoming. Some of you will have a simple formula that can be handled in this line, and others may require a more

Program listing.

```
0100 PRINT CHR(16); CHR(22)
0110 READ Z
0120 DIM E(Z,14)
0130 PRINT "PAYROLL PROGRAM FOR 6800"
0140 PRINT
150 PRINT "BY RON S. HARVEY, SR. PARTNER"
0160 PRINT "COMPUTER RADIO WORKSHOP"
0170 PRINT "CHEYENNE, WYOMING"
0180 PRINT
0250 PRINT "PAY PERIOD ENDING (M D Y) ";
0260 INPUT M, D, Y
0270 FOR N = 1 TO Z
0280 READ E(N,1), E(N,2), E(N,3), E(N,4)
0290 IF E(N,4) = 0 THEN 330
0300 PRINT CHR(22)
0310 PRINT "EMP.NO. "; (N + 1000), "HRS PAID ";
0320 INPUT E(N,5)
0330 NEXT N
0340 PRINT "CORRECTIONS ";
0350 INPUT A
0360 IF A = 0 THEN 430
0370 PRINT "EMP.NO. ";
0380 INPUT A
0390 LET N = A-1000
0400 PRINT "EMP.NO. "; (N + 1000), "HRS PAID ";
```

```
0410 INPUT E(N,5)
0420 GOTO 340
0430 FOR N = 1 TO Z
0440 IF E(N,5) >40 THEN 470
0450 LET E(N,6) = E(N,4) * E(N,5)
0460 GOTO 480
0470 LET E(N,6) = E(N,4) * E(N,5) + E(N,4)/2*(E(N,5)-40)
0480 LET E(N,6) = INT (E(N,6) * 100 + .5)/100
0490 LET E(N,7) = INT ((E(N,6) * .0585) * 100+.5)/100
0520 IF E(N,2) = 0 GOSUB 1100
0530 IF E(N,2) = 1 GOSUB 1200
0540 LET E(N,8) = INT (E(N,8) * 100 + .5)/100
0550 LET E(N,9) = 0
0560 LET E(N,14) = E(N,6) - E(N,7) - E(N,8) - E(N,9)
0610 LET F = F + E(N,7)
0620 LET I = I + E(N,8)
0630 LET L = L + E(N,9)
0640 LET P = P + E(N,14)
0650 IF E(N,4) = 0 THEN 700
0660 IF E(N,5) = 0 THEN 700
0670 GOSUB 720
0680 PRINT "CONTINUE ";
0690 INPUT
0700 NEXT N
0710 GOTO 920
0720 PRINT "CHR(16); CHR(22)
0730 PRINT "EMP.NO. "; (N + 1000), "DATE "; M; D; Y
0740 PRINT "SS "; E(N,1), "RATE ' ; E(N,4)
0750 IF E(N,2) = 0 GOSUB 880
0760 IF E(N,2) = 1 GOSUB 900
0770 PRINT
0780 PRINT TAB (10); "PAY", "Y-T-D"
0790 PRINT "GROSS                "; E(N,6)
0800 PRINT "F.I.C.A.             "; E(N,7)
0810 PRINT "F.I.T.               "; E(N,8)
0820 PRINT "MISC                 "; E(N,9)
0830 PRINT "                       ------"
0840 PRINT "NET PAY "; E(N,14)
0850 PRINT
0860 PRINT
0870 RETURN
0880 PRINT "SINGLE "; E(N,3), "HRS "; E(N,5)
0890 RETURN
0900 PRINT "MARRIED "; E(N,3), "HRS "; E(N,5)
0910 RETURN
0920 PRINT "RECORD FILE COPY ";
0930 INPUT A
0940 IF A = 0 THEN 1300
0950 IF A >1 THEN 930
0960 FOR N = 1 TO Z
0970 GOSUB 720
0980 NEXT N
0990 GOTO 1300
1000 DATA Z
1001 DATA E(N,1), E(N,2), E(N,3), E(N,4)
1002      (SEE TEXT FOR DATA VALUES)
1099 DATA
1100 LET G = E(N,6) - (E(N,3) * 14.40)
1110 IF G >=      346 THEN E(N,8)  =  (G-346)*  .36 + 74.17
1120 IF G <       346 THEN E(N,8)  =  (G-279)*    .3 + 54.07
1130 IF G <       279 THEN E(N,8)  =  (G-240)*  .26 + 43.93
1140 IF G <       240 THEN E(N,8)  =  (G-183)*  .21 + 31.96
1150 IF G <       183 THEN E(N,8)  =  (G-115)*  .23 +16.32
1160 IF G <       115 THEN E(N,8)  =  (G- 67)*  . 2 +  6.72
1170 IF G <        67 THEN E(N,8)  =  (G- 25)*  .16
1180 IF G <        25 THEN E(N,8)  =  0
1190 RETURN
1200 LET G = E(N,3)* 14.40)
1210 IF G >= 500 THEN E(N,8) = (G-500)* .36 + 105.33
1220 IF G <       500 THEN E(N,8)  =  (G-433)*  .32 + 83.89
1230 IF G <       433 THEN E(N,8)  =  (G-346)*  .28 + 59.53
1240 IF G <       346 THEN E(N,8)  =  (G-264)*  .25 + 39.03
1250 IF G <       264 THEN E(N,8)  = ( (G-173)*  .17 + 23.56
1260 IF G <       173 THEN E(N,8)  =  (G- 96)*  . 2 +  8.16
1270 IF G <       96  THEN E(N,8)  =  (G- 48)*  .17
1280 IF G <        48 THEN E(N,8)  =  0
1290 RETURN
1300 PRINT CHR(16); CHR(22)
1310 PRINT "PAYROLL SUMMARY FOR "; M; D; Y
1320 PRINT
1330 PRINT "FICA EMPLOYER", F
1340 PRINT "FICA WITHHELD", F
1350 PRINT "F.I.T. WITHHELD", I
1360 PRINT "MISC. WITHHELD", L
1370 PRINT
1380 PRINT "NET PAYROLL", P
1390 PRINT
1400 PRINT "PAYROLL COST "; P + L + I + (2*F)
1410 PRINT
1560 END
```

complex tax table, in which case a GOSUB statement can be inserted at line 550. You're on your own!

Line 560 subtracts all these deductions from gross and establishes the employee's net pay E(N,14). This completes the calculations for the employee, but before outputting them we gather some totals for the payroll summary. This is done in lines 610 through 640 where F is FICA, I is federal income tax, L is local income tax and P is net pay. These are accumulated and totaled for all employees. The program will output all the preceding information in order to write the paychecks, but before this happens a decision is made at line 650 and 660. If either rate of pay or paid hours is equal to zero, we skip the output routine and go to next employee. Remember, calculations and employee data are held even if equal to 0, just not printed at this time.

If the employee has a paycheck coming, then the Print subroutine is called in at line 670 and printed out as shown in Photo 2. At the bottom the word "continue?" appears. This is an undefined input prompt (line 690) which stops the program in order to write the paycheck. When ready for the next employee, simply hit return.

On completion of all employees the program continues at line 920 to ask if you're ready to record a file copy to audio tape for a permanent file. A 0 response will bypass this function and continue at line 1300 for summary data. A 1 response will repeat the print routine for each employee without a pause (check writing) and also include the employees whose rate or hours were 0. This keeps all employees and hours on a permanent file. On completion of this run the print routine continues without pause (line 980 GOTO 1300), into the Payroll Summary routine. This will tell you how much you owe the government in employee contributions to social security and employee withholdings. It also gives the net payments made and your cost for the payroll. This is supposed to make you feel good, and ends the payroll program for the 6800.

Limitations

The program as described and listed is complete for a weekly payroll routine and with appropriate changes in hours calculations and tax tables can be used for a biweekly or monthly payroll. The program also provides a permanent record of employee hours, pay and deductions. However, it does suffer from a particular malady. Since BASIC doesn't provide a way to write to a data file and retrieve it later, year-to-date totals cannot be maintained, which means they have to be kept separately for each employee. Since they are maintained in a permanent file, W2 Forms can be prepared by review at the end of the year. The other problem, however, is social security deductions. They must stop at $965.25 paid, or on income over $16,500. On employees earning more than this, they would have to be reviewed before the end of the year.

However, have patience and fortitude; all things come to those who wait. If you examine the line-number sequence carefully you will notice some omissions throughout the program and a large gap between the end of the Summary (line 1410) and END (line 1560).

These "missing links" are the key to the development of a simple, inexpensive computer system, using a small version of a high-level language (BASIC), into a sophisticated system that will maintain a data file. All this without additional cost. The additional lines for this program and the techniques to expand this and other programs will be the subject of my next article. ■

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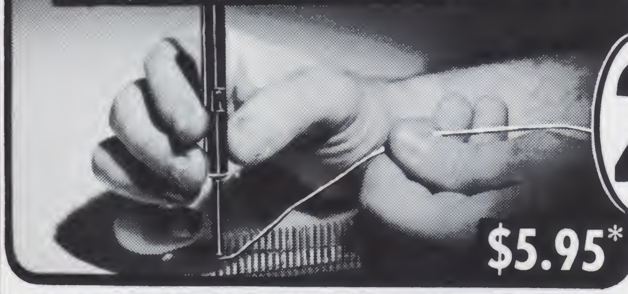

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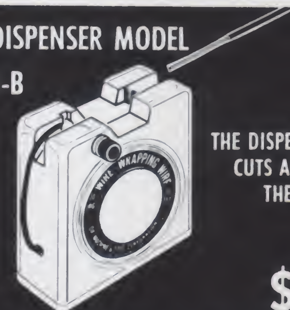

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SC/MP Goes Baudot

. . . add an inexpensive TTY

OK, I've paid a hundred bucks for this thing, now what is it good for? Actually, I played with the SC/MP for six months before I had even one good idea. The idea that finally jelled into a workable concept was more or less forced on me by the ancient and diabolical wiring in my home, and the frustration of having a Baudot Teletype I couldn't use.

Every time I managed to get a program loaded into my M6800 and halfway debugged, the main fuse in the house would blow, and I'd have to go back to the original handwritten version and start all over again. I had to have hard copy as I worked. So finally I had a use for my SC/MP. I would make the thing do the timing and formatting for my TTY!

Hardware Arrangement

That was the extent of the original idea. The hardware arrangement remained the same in both the original configuration and the final version. It was set up so that the 6800 did the actual code con-

0500	8E	A047	LDS	Saves beginning address so you can restart with the "G" of Mikbug(c)
0503	CE	0000	LDX	Initialize timing loop;
0506	FF	051E	STX	Saves count in 051E;
0509	CE	8014	LDX	Sets up interface address;
050C	86	11	LDAA	Sets baud and stp bits in the interface;
050E	A7	00	STAA	Sets baud and stp bits in the interface;
0510	86	01	LDAA	Checks for high "buffer full" bit in interface control reg;
0512	A4	00	ANDA	Checks for high "buffer full" bit in interface control reg;
0514	27	07	BEQ	If buffer not full, go to 051D, otherwise, go on;
0516	A6	01	LDAA	Loads ACCA from buffer;
0518	BD	E1D1	JSR	Outputs char. now in ACCA to TTY or terminal;
051B	20	E6	BRA	Goes to 0503 to check for new character;
051D	CE	xxxx	LDX	Loads the saved count into index register;
0520	08		INX	Increments count;
0521	8C	08FF	CPX	Is count equal to 08FF?;
0524	27	05	BEQ	If equal to 08FF, go to 052B, otherwise, go on;
0526	FF	051E	STX	Saves count in 051E;
0529	20	DE	BRA	Goes to 0509 to keep looking for a character;
052B	86	40	LDAA	Load ASCII character "@" into ACCA;
052D	BD	E1D1	JSR	Uses Mikbug(c) to Print "@" in ACCA;
0530	86	12	LDAA	Loads a backspace into ACCA;
0532	BD	E1D1	JSR	Uses Mikbug(c) to Print a backspace;
0535	CE	8014	LDX	Sets up interface address;
0538	BD	E1AC	JSR	Uses Mikbug(c) to Get a character from the TTY or terminal;
053B	A7	01	STAA	Loads said character into the interface;
053D	81	2A	CMPA	Is character a "*"?;
053F	26	C2	BNE	If it was not a "*", go to 0503 and look for output from SC/MP;
0541	7E	E0D0	JMP	Go to Mikbug(c) control.
04F9	CE	8014	LDX	Sets up interface address;
04FC	86	13	LDAA	Clears all registers in the interface;
04FE	A7	00	STAA	Clears all registers in the interface.

Program 1. Program to output ASCII characters to SC/MP. To relocate this program, you must change the addresses at locations 0506 and 0526. This will enable you to move the program to where it is convenient for your available memory space. You MUST have MIKBUG for this program to execute properly. Start the program running at 04F9. The terminal should print an @; you may now enter a character, which will be transferred to the SC/MP. Do not enter another character until your terminal has printed an @. To exit the program, simply type an asterisk. This is the program to use to load data to the SC/MP — do not use it until you have the hardware connected properly.

version and output the "Baudot arranged" byte to the SC/MP. The SC/MP would then time the bits and output them in the proper order to a couple of transistors, which actually handled the 60 mA current loop required by the TTY (see Fig. 1).

In the final version, the 6800 only takes care of the figures/letters shift code formatting, and not the code conversion. I would have had the SC/MP doing that too, but I could not make the program short enough to fit it all in the SC/MP's 256 bytes of R/W memory. The SC/MP receives the ASCII data, looks it up in a table, puts the value in the extension register and outputs it bit by bit.

The SC/MP operates at 110 baud, so unless your computer is very slow, you will have to wait. The timing loop in my 6800 is long enough that the SC/MP can receive input from the 6800 and output to the TTY before control is returned, so I can't interrupt a byte halfway.

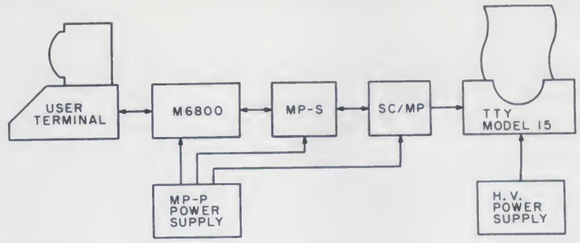

Fig. 1. System block diagram.

Modifications

The hardware was fairly simple and required only a few modifications to the interface and the SC/MP. These are detailed in Fig. 2, and as follows.

On the SC/MP attach a 15k resistor (R1) to the SOUT pin, then attach the Zener diode (D1) as shown to ground. Another 15k resistor (R2) goes from here to a spare pin on the SC/MP card. This pin is then connected to the base of Q1.

Mount an RS7805 (IC1) positive 5 volt regulator on the board with a small heat sink. Attach the 8 volt bus on the 6800 to the pin on the SC/MP which is connected to the input of the regulator. The output goes to the positive 5 volt bus on the SC/MP. *Do not connect anything else to that bus!* Connect the ground pin on the SC/MP to the ground bus on the 6800. Use a 1 uF capacitor on both input *(C1) and* output (C2) of the 7805. These go to ground. Cut one end free of both C5 and R4 (you can find these on the SC/MP schematic). Now, on the SC/MP edge connector: pin 4 to the ground pin on your MP-S interface; pin 5 to TO pin on the MP-S; pin 12 to T1 pin on the MP-S.

Modify the MP-S as

```
0100  F7  0117  STAB   Save ACCB;
0103  FF  0112  STX    Save index reg;
0106  B7  0115  STAA   Save ACCA;
0109  B7  0141  STAA   Load print regs;
010C  B7  014F  STAA   Load print regs;
010F  8D  08    BSR    Execute Subroutine — go to 0119;
0111  CE  xxxx  LDX    Reload index reg;
0114  86  xx    LDAA   Reload ACCA;
0116  C6  xx    LDAB   Reload ACCB;
0118  39        RTS    Return to main program; (end subroutine)
0119  81  0A    CMPA   Is data in ACCA a line feed?;
011B  27  18    BEQ    If it is, then go to 0135; otherwise, continue;
011D  81  0D    CMPA   Is data in ACCA a carriage return?;
011F  27  14    BEQ    If it is, then go to 0135, otherwise, continue;
0121  81  20    CMPA   Is data in ACCA a space?;
0123  27  10    BEQ    If it is, then go to 0135, otherwise, continue;
0125  16  TAB   Transfer data in ACCA to ACCB;
0126  86  5B    LDAA
0125  16        TAB    Transfer data in ACCA to ACCB;
0126  86  5B    LDAA   Set up ACCA with highest permissible ASCII;
0128  10        SBA    Subtract data in ACCB from ACCA;
0129  2F  31    BLE    Data larger than is permissible, go to 015C;
012B  86  21    LDAA   Set up ACCA with lowest permissible ASCII;
012D  10        SBA    Subtract data in ACCB from ACCA;
012E  2E  2C    BGT    Data smaller than permissible, go to 015C;
0130  86  40    LDAA   Set up ACCA with lowest non-shift Baudot character;
0132  10        SBA    Subtract data in ACCB from ACCA;
0133  2C  12    BGE    Data is a character to be shifted, go to 0147, otherwise, continue;
0135  CE  8014  LDX    Set up interface address;
0138  86  13    LDAA   Clear interface registers;
013A  A7  00    STAA   Clear interface registers;
013C  86  11    LDAA   Sets baud and stop bits in the interface;
013E  A7  00    STAA   Sets baud and stop bits in the interface;
0140  86  xx    LDAA   Put data to be printed in ACCA;
0142  A7  01    STAA   Loads said data into the interface;
0144  8D  1D    BSR    Go to 0163 and wait;
0146  39        RTS    Return to whence thou came (0111, 014E, 0155, or 015C);
0147  86  00    LDAA   Set up ACCA with figures shift;
0149  B7  0141  STAA   Load ACCA into print reg;
014C  8D  E7    BSR    Go to 0135 and send out figures shift;
014E  86  xx    LDAA   Put data to be printed in ACCA;
0150  B7  0141  STAA   Load ACCA into print reg;
0153  8D  E0    BSR    Go to 0135 and send out upper case data;
0155  86  01    LDAA   Set up ACCA with letters shift;
0157  B7  0141  STAA   Load ACCA into print reg;
015A  20  D9    BRA    Go to 0135 and send out letters shift (will now go from 0146 to 0111);
015C  86  02    LDAA   Set up ACCA with bell;
015E  B7  014F  STAA   Load ACCA into print reg;
0161  20  E4    BRA    Go to 0147 and send out bell;
0163  CE  0000  LDX    Initialize timing loop;
0166  08        INX    Increment count;
0167  8C  8000  CPX    Is count 8000?;
016A  26  FA    BNE    If not, go to 0166, otherwise, continue;
016C  39        RTS    Return to 0146;
```

Program 2. Print character subroutine. To relocate this program, you must change the address at locations 0100, 0103, 1006, 1019, 100C, 0149, 0150, 0157, and 015E. This will enable you to move the body of the routine where you wish. This is a subroutine — use an 8K (BSR) or an BD (JRS) to access it or it won't work.

follows: Break the foil that goes to the TO pin. Use a jumper wire from the TO pin to pin 11 of IC3. Jumper configure the interface for 110 baud. The interface goes in position #5 on the motherboard.

Additional Items

Q1 and Q2 are RCA SK 3537 or high voltage (over 200) power transistors, NPN only. You also need a power supply (12 V dc at 200 mA), and a single pole, single throw switch for the reset on the SC/MP. Use Program 1 to load data to the SC/MP from the main system. (SC/MP gets Program 3.) Use Program 2 for a callable subroutine to print. This will save all registers.

Now that I have actually used the SC/MP for something, I begin to realize just how many handy inputs and outputs the thing has. I've been thinking about this model boat I have, "suitable for radio control . . ." ■

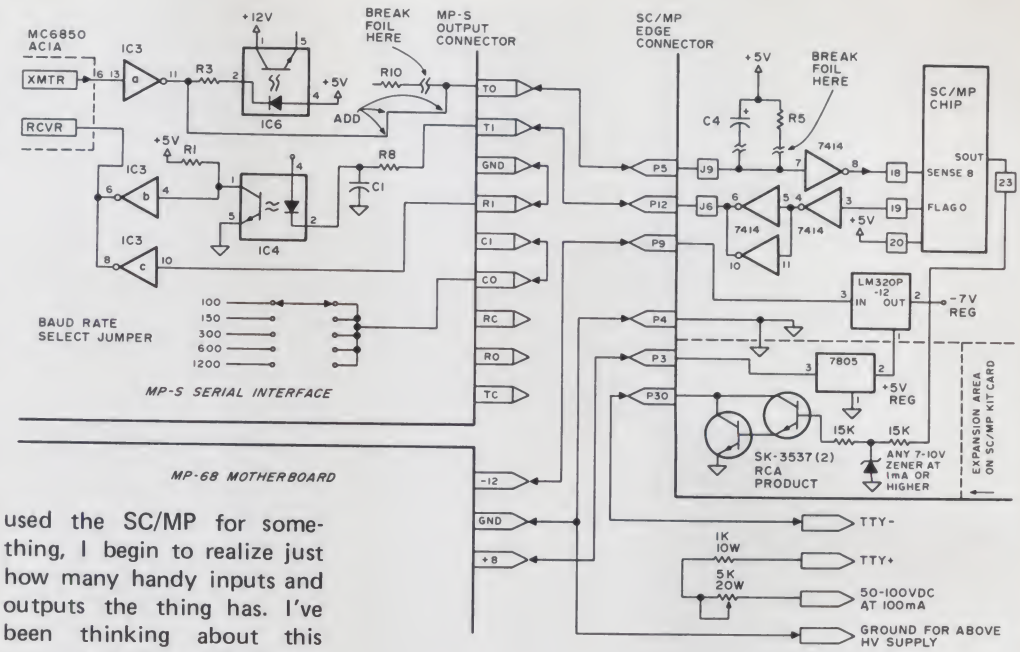

Fig. 2. 6800/SCMP/TTY interface diagram.

```
0F80  C4  01   LDI    Load ACC with MSBYTE of subroutine;
0F82  37       XPAH   Exchange MSBYTE of ptr register P3 with the ACC;
0F83  C4  85   LDI    Load ACC with LSBYTE of subroutine;
0F85  33       XPAL   Exchange LSBYTE of ptr register P3 with the ACC;
0F86  3F       XPPC   Go Subroutine 0186 . . . this gets the data from the MP-S interface;
0F87  33       XPAL   Exchange LSBYTE of ptr register P3 with the ACC; (P3 now=xxXX-XX is ASCII)
0F88  C4  0F   LDI    Load ACC with MSBYTE of table address;
0F8A  37       XPAH   Exchange ACC with MSBYTE of P3; (p3 now=0FXX-XX is ASCII)
0F8B  C3  00   LD     Load ACC with byte addressed by P3;
0F8D  01       XAE    Exchange ACC with the Extension register;
0F8E  C4  FF   LDI    Set up ACC for DLY instruction;
0F90  19       SIO    Output bit #1 of Extension register;
0F91  8F  30   DLY    Wait 1 bit time; (actually, longer — this is the start bit)
0F93  19       SIO    Output bit #2 of Extension register;
0F94  8F  0B   DLY    Wait 1 bit time;
0F96  19       SIO    Output bit #3 of Extension register;
0F97  8F  13   DLY    Wait one bit time;
0F99  19       SIO    Output bit #4 of Extension register;
0F9A  8F  15   DLY    Wait 1 bit time;
0F9C  19       SIO    Output bit #5 of Extension register;
0F9D  8F  14   DLY    Wait 1 bit time;
0F9F  19       SIO    Output bit #6 of Extension register;
0FA0  8F  15   DLY    Wait 1 bit time;
0FA2  19       SIO    Load ACC with MSBYTE of subroutine;
0FA3  8F  13   DLY    Exchange ACC with MSBYTE of P3;
0FA5  C4  0F   LDI    Load ACC with MSBYTE of subroutine;
0FA7  37       XPAH   Exchange ACC with MSBYTE of P3;
0FA8  C4  7F   LDI    Load ACC with MSBYTE of subroutine;
0FAA  33  XP   XPAL   Exchange ACC with LSBYTE of P3;
0FAB  3F       XPPC   Exchange P3 with Program counter, thereby Jumping to 0F7F;
0F00-F6   0F10-CA   0F20-C8   0F30-EC   0F40-CA   0F50-EC
0F01-FE   0F11-CA   0F21-DA   0F31-EE   0F41-C6   0F51-EE
0F02-CA   0F12-CA   0F22-E2   0F32-E6   0F42-F2   0F52-D4
0F03-CA   0F13-CA   0F23-CA   0F33-C2   0F43-DC   0F53-CA
0F04-CA   0F14-CA   0F24-D2   0F34-D4   0F44-D2   0F54-E0
0F05-CA   0F15-CA   0F25-CA   0F35-E0   0F45-C2   0F55-CE
0F06-CA   0F16-CA   0F26-F4   0F36-EA   0F46-DA   0F56-FC
0F07-CA   0F17-CA   0F27-D6   0F37-CE   0F47-F4   0F57-E6
0F08-CA   0F18-CA   0F28-DE   0F38-CC   0F48-E8   0F58-FA
0F09-CA   0F19-CA   0F29-E4   0F39-F0   0F49-CC   0F59-EA
0F0A-C4   0F1A-CA   0F2A-CA   0F3A-D6   0F4A-D6   0F5A-E2
0F0B-CA   0F1B-CA   0F2B-CA   0F3B-FC   0F4B-DE   ***********************
0F0C-CA   0F1C-CA   0F2C-D8   0F3C-CA   0F4C-E4
0F0D-D0   0F1D-CA   0F2D-C6   0F3D-CA   0F4D-F8
0F0E-CA   0F1E-CA   0F2E-F8   0F3E-CA   0F4E-D8
0F0F-CA   0F1F-CA   0F2F-FA   0F3F-F2   0F4F-F0
```

Program 3. ASCII-to-Baudot conversion routine. This is the program that actually goes in the SC/MP. Set the program counter at 0FF7 and 0FF8 to 0F and 80, respectively, and type G and a carriage return, and it will work well with a model 15 TTY. For a different baud rate on the TTY, change the value of the data in the DLY instructions.

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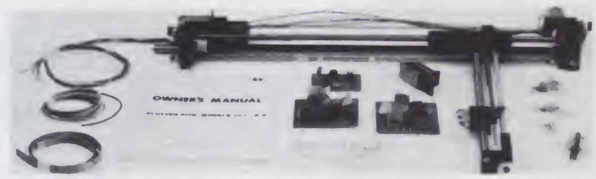

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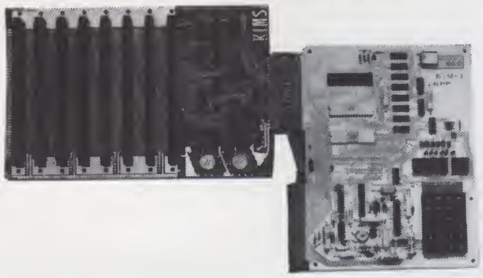

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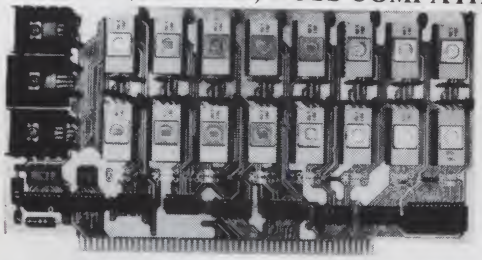

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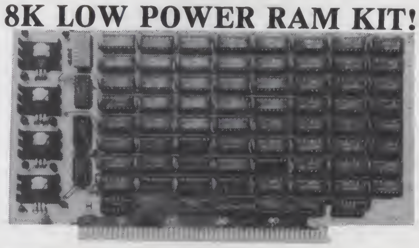

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7400N	.15
7401N	.16
7402N	.18
7403N	.19
7404N	.19
7405N	.22
7406N	.29
7407N	.29
7408N	.25
7409N	.25
7410N	.18
7411N	.28
7412N	.39
7413N	.45
7414N	.69
7416N	.35
7417N	.35
7420N	.20
7421N	.33
7422N	.37
7423N	.37
7425N	.39
7426N	.35
7427N	.35
7428N	.49
7430N	.22
7432N	.31
7437N	.27
7438N	.27
7440N	.22
7441N	.85
7442N	.59
7443N	.75
7444N	.75
7445N	.75
7446N	.79
7447N	.65
7448N	.75
7450N	.22
7451N	.26
7453N	.26
7454N	.22
7459N	.29
7460N	.29
7470N	.44
7472N	.36
7473N	.36
7474N	.31
7475N	.48
7476N	.36
7479N	.36
7480N	.69

7482N	.99
7483N	.70
7485N	.97
7486N	.39
7488N	3.95
7489N	2.25
7490N	.45
7491N	.65
7492N	.45
7493N	.45
7494N	.75
7495N	.79
7496N	.99
7497N	4.25
74100	.99
74104	.69
74105	.69
74107	.39
74109	.49
74121	.35
74122	.49
74123	.85
74125	.58
74126	.58
74132	1.05
74136	1.10
74141	1.10
74142	3.75
74143	3.95
74144	4.95
74145	1.05
74147	2.25
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74154	1.29
74155	.99
74156	.95
74157	.95
74158	1.79
74160	1.20
74161	.95
74162	.95
74163	.95
74164	1.06
74165	1.05
74166	1.00
74170	2.49
74172	8.49
74173	1.49
74174	1.25
74175	.90
74176	.90
74177	.90
74180	.89
74181	2.39
74182	.95
74184	2.10
74185	2.25
74186	14.50
74190	1.15
74191	1.15
74192	.99
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74194	1.39
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74196	1.19
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LS10	.28
LS13	.79
LS14	1.89
LS20	.26
LS27	.38
LS30	.26
LS32	.34
LS40	.28
LS42	1.10
LS51	.26
LS73	.56
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LS75	.79
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LS138	1.39
LS139	1.49
LS151	1.49
LS153	1.49
LS155	1.49
LS157	1.29
LS158	1.29
LS161	1.39
LS162	1.39
LS163	1.39
LS164	1.39
LS174	1.39
LS175	1.39
LS190	2.49
LS191	2.49
LS192	2.49
LS193	2.49
LS194	2.49
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74S20	.40
74S30	.40
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74S138	1.89
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74S174	1.59
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74L30	.39
74L42	1.29
74L73	.89
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74L85	1.49
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CD4021	1.85
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CD4023	.29
CD4024	1.25
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CD4026	1.95

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CD4028	1.50
CD4029	1.70
CD4030	.42
CD4033	2.49
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CD4042	1.45
CD4043	1.45
CD4044	1.45
CD4047	1.95
CD4049	.61
CD4050	.61
CD4051	1.25
CD4052	1.25
CD4059	1.95
CD4063	2.49
CD4068	.35
CD4069	.35
CD4070	.35
CD4071	.35
CD4072	.36
CD4073	.35
CD4075	.35
CD4078	.35
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CD4082	.40
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4515	3.95
4516	1.99
4518	1.99
4520	2.49
4522	2.56
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4527	2.69
4528	1.50
4531	1.99
4532	2.89
4543	2.25
4555	1.79
4556	1.79
4581	4.90
4582	1.99
4585	2.49
4901	.49
4911	.49
74C00	.35
74C04	.35
74C10	.35
74C20	.35
74C30	.35
74C42	1.95
74C48	2.90
74C73	.85
74C74	.85
74C78	1.39
74C85	1.25
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74C89	4.95
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74C93	1.35
74C95	1.49
74C106	1.49
74C107	1.10
74C151	1.70

74C154	2.75
74C160	1.40
74C161	2.10
74C174	2.10
74C192	2.39
74C193	2.39
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LM301H	.45
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LM302H	1.25
LM304H	1.20
LM305H	.85
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LM308H	1.00
LM308CN	1.00
LM309H	1.10
LM309K	1.25
LM310H	1.15
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LM709CH	.49
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LM711CH	.49
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LM733H	1.29
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LM747N	.75
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P2102	16/17.95
74125	10/3.75
LM323K	2/12.95
MCT2	99
WD4060 22 pin	3.25
1771 Floppy	59.95

★ 8K Ram Kit $179.95 ★

Plus huge backup inventory with special pricing for VOLUME requirements. Call for a quotation

S 100 Memory Module		
Logos 8K RAM	Kit $179.95	Assem $199.95
Fully buffered address selectable		
Logos 8K Memory Board only		$ 28.95
S 100 32K STATIC Memory Kit	$999.99	Assem $1099.99
8 slot expandable Mother Board w/conn		$ 79.95
S 100 Extender Board		$ 15.95
S 100 Protoboard w/Instructions		$ 21.95
8K EPROM Kit		$ 89.95
Tarbell Cassette I/O		$115.00
Tarbell Cassette PC Board		$ 36.95
IMSAI 8080 Kit w 22 slot and with 8K RAM Kit Special Price		$899.99

All Shipments FCM or UPS. Orders under $100.00 add 5% handling and postage. Orders over $100.00 add 2.5% handling & postage. Mastercharge/Bank-americard/COD accepted w/25% deposit. California Residents add 6% tax. Foreign Orders add 8% handling. All parts prime factory tested guaranteed. Same day shipment. Add 25 cents for Data.

SPECIALTY CHIPS

34702 Baud Rate Gen	$15.95
upD372 Floppy Controller	55.00
upD371 Mag Tape Controller	49.95
App Notes for 372 Floppy	6.95
WD1771 Floppy Controller	59.95
AY5 3550 4½ DVM Chip	24.95
MK5007 Counter	6.95
AY5 3507 DVM Chip	12.95
WD1941 Dual Baud Gen	9.95
ICM7208IPI Ctr Disp. Driver	16.95
ICM7045IPI Stop Watch Chip	18.95
MC14411 Baud Rate Gen	12.95
CW300 Saw Fcn. Gen.	1.50
RF Modulator	8.95
8500-1 TV Game Chip	24.95
MM57100 Game Chip	16.95
MM53104 Clock	3.75
LM1889 Modulator	3.95

Retail pricing may vary from Mail Order Pricing

ADVANCED COMPUTER PRODUCTS

P. O. BOX 17329
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New Phone (714) 558-8813

★ NOW Our First Store Open
1310 B Edinger
Santa Ana, CA 92705 ★

Bearcat® 210 $289.

The **Bearcat® 210** is a sophisticated scanning instrument with the ease of operation and frequency versatility you've dreamed of. Imagine, selecting from any of the public service bands and from all local frequencies by simply pushing a few buttons. No longer are you limited by crystals to a given band and set of frequencies. It's all made possible by *Bearcat* spaceage solid state circuitry. You can forget crystals forever.

Pick the 10 frequencies you want to scan and punch them in on the keyboard. It's incredibly easy. The large decimal display reads out each frequency you've selected. When you want to change frequencies, just enter the new ones.

Automatic search lets you scan any given range of frequencies of your choice within a band. Push-button lockout permits you to selectively skip frequencies not of current interest. The decimal display with its exclusive "rolling zeros" tells you which channels you're monitoring. When the *Bearcat* 210 locks in on an active frequency the decimal display shows the channel and frequency being monitored.

With the patented track-tuning system, the Bearcat 210 automatically aligns itself so that circuits are always "peaked" for any broadcast. Most competitive models peak only at the center of each band, missing the frequencies at the extreme ends of the band.

The Bearcat 210's electronically switched antenna eliminates the need for the long low band antenna. And a quartz crystal filter rejects adjacent stations as well as noise interference.

Call toll-free 800-521-4414 now to place a BankAmericard or Master-charge order. This is our 24 hour phone to our order department and only orders may be processed on this line. To order in Michigan or outside of the U.S. dial 313-994-4441.

Add $5.00 for U.S. shipping or $9.00 for air UPS to west coast. Charge cards or money orders only please. International orders invited. Michigan residents add tax. Please write for quantity pricing.

Bearcat® 210 Features

- **Crystal-less**—Without ever buying a crystal you can select from all local frequencies by simply pushing a few buttons.
- **Decimal Display**—See frequency and channel number—no guessing who's on the air
- **5-Band Coverage**—Includes Low, High, UHF and UHF "T" public service bands, the 2-meter amateur (Ham) band, plus other UHF frequencies
- ***Deluxe Keyboard**—Makes frequency selection as easy* as using a push-button phone Lets you enter and change frequencies easily try everything there is to hear
- **Patented Track Tuning**—Receive frequencies across the full band without adjustment Circuitry is automatically aligned to each frequency monitored
- **Automatic Search**—Seek and find new, exciting frequencies.
- **Selective Scan Delay**—Adds a two second delay to prevent missing transmissions when "calls" and "answers" are on the same frequency
- **Automatic Lock-Out**—Locks out channels and "skips" frequencies not of current interest
- **Simple Programming**—Simply punch in on the keyboard the frequency you wish to monitor
- **Space Age Circuitry**—Custom integrated circuits a *Bearcat* tradition
- **UL Listed/FCC Certified**—Assures quality design and manufacture.
- **Rolling Zeros**—This *Bearcat* exclusive tells you which channels your scanner is monitoring.
- **Tone By-Pass**—Scanning is not interrupted by mobile telephone tone signal
- **Manual Scan Control**—Scan all 10 channels at your own pace.
- **3-Inch Speaker**—Front mounted speaker for more sound with less distortion
- **Squelch**—Allows user to effectively block out unwanted noise.
- **AC/DC**—Operates at home or in the car.

Bearcat® 210 Specifications

Frequency Reception Range

Low Band	32—50 MHz
"Ham" Band	146—148 MHz
High Band	148—174 MHz
UHF Band	450—470 MHz
"T" Band	470—512 MHz

*Also receives UHF from 416—450 MHz

Size
10⅝" W x 3" H x 7⅝" D

Weight
4 lbs. 8 oz.

Power Requirements
117V ac, 11W; 13.8 Vdc, 6W

Audio Output
2W rms

Antenna
Telescoping (supplied)

Sensitivity
$0.6\mu v$ for 12 dB SINAD on L & H bands
U bands slightly less

Selectivity
Better than −60 dB @ ± 25 KHz

Scan Rate
20 channels per second

Connectors
External antenna and speaker; AC & DC power

Accessories
Mounting bracket and hardware
DC cord

TM
COMMUNICATIONS ELECTRONICS
Box 1002
Ann Arbor, Michigan 48106 USA

master charge
THE INTERBANK CARD

Your BANKAMERICARD welcome here

C5

This is a business machine.

It goes where the big planes can't go. It follows your schedule rather than the other way around. It can have you doing business tonight, in person, instead of waiting in an airport to catch the next flight out.

Our job, as an air taxi/charter service, is to fly wherever and whenever you want. And if you thought only the very big guys could afford this kind of convenience, you may be surprised to find that for many trips an air taxi costs less than commercial airlines.

Want to find out how to save time and money while improving overall efficiency? Give us a call at (415) 562-0636. **We understand business machines as well as we understand flying.**

WILLIAM J. GODBOUT CO. OAKLAND INT'L. AIRPORT, CA 94614

Our parent company ran this ad in the September 1977 issue of *The Office* magazine. Since many of you Kilobaud readers are business people who conduct a fair amount of business in the Bay Area/Silicon Gulch, we thought you might also like to know about our air taxi/charter service. Flying is the ideal way to touch base—economically—in a number of places. And, we can even provide a pilot who speaks electronics.

Call (415) 562-0636 when you need the convenience and efficiency of an experienced air taxi service.

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BOX 2355, OAKLAND AIRPORT, CA 94614

G4

From Parts to Peripherals:

a one stop, mail-order computer store, serving computer enthusiasts since 1973.

Vector VP2 Assembled Microcomputer Case

This adjustable packaging system for S-100 buss microcomputers is compatible with Altair 8800 and IMSAI 8080 size cards. Outside, it is beautiful...with a dark blue textured vinyl finish and lines unmarred by external screws or fasteners. Inside, there is space for 21 cards total (on 0.75" centers) with a fully adjustable interior card mounting system (card guides and hardware provided for 12 cards). The interior is instantly accessible, the rear and front panels are removable and recessed. If you want a classy home for your micro, check this out...it is the best we have seen.

VP2 ASSEMBLED MICROCOMPUTER CASE....$134.30

CRYSTALS

STATEK 3 TERMINAL CRYSTALS.......$4.95 each
(all frequencies in KHz)

10.000	12.800	15.360	16.000	16.384
18.641	19.200	20.480	24.576	30.720
31.500	32.768	36.864	38.400	40.960
60.000	76.800	100.00	153.60	240.00

SENTRY CRYSTALS: SERIES MODE, FUNDAMENTAL, WIRE LEADS, HC18 PACKAGE.........$4.95 each
(all frequencies in MHz)

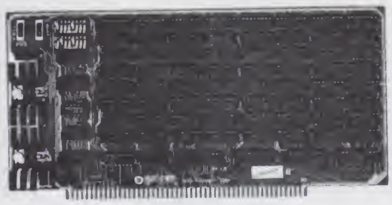
4.0	4.5315	5.0	8.0	9.0
10.0	12.0	15.0	18.0	20.0

MISCELLANEOUS CRYSTALS

500 KHz, series mode, fundamental, HC6/U package, wire leads..............**$4.95 each**
1 MHz, series mode, fundamental, wire leads in HC6/U package.................**$5.95 each**
2 MHz, series mode, fundamental, wire leads in HC6/U package.................**$5.90 each**

8Kx8 Econoram II™

single kit $163.84
3 kits-24K!-$450



Those who know memory recognize the Godbout board as not just an exceptional value (it's no secret we know how to keep costs down), but as an example of how to pack extra options into a basic memory board. Extras like a vector interrupt provision if you try to write into protected memory. Configuration as **two** independent 4K blocks (both protectable separately). A selectable write strobe for either PWR or MWRITE. An all static design, free of timing and refresh problems. Guaranteed speed under 450 ns (with on-board wait state logic for use with 4 MHz Z-80) and guaranteed current under 1.5A (1250 mA typ). And of course...sockets for all ICs, legended board with solder mask, one year warranty on parts...**we've got it all.**

ALSO AVAILABLE: 8K ASSEMBLED, TESTED, WARRANTED 1 YEAR...$188.50; 4K KIT...$100.

Low power Schottky

74LS00	$0.30	74LS151	$0.95
74LS01	0.30	74LS155	1.38
74LS02	0.30	74LS157	0.95
74LS04	0.33	74LS160	1.40
74LS08	0.36	74LS161	1.40
74LS10	0.30	74LS162	1.40
74LS11	0.36	74LS163	1.40
74LS12	0.33	74LS168	1.87
74LS14	1.38	74LS169	1.87
74LS15	0.30	74LS173	1.65
74LS20	0.30	74LS174	1.25
74LS21	0.33	74LS175	1.15
74LS22	0.33	74LS195	1.30
74LS26	0.43	74LS240	1.88
74LS27	0.36	74LS257	1.25
74LS30	0.30	74LS258	1.25
74LS32	0.38	74LS266	0.53
74LS37	0.45	74LS283	1.20
74LS38	0.45	74LS365/80LS95	0.75
74LS42	0.98		
74LS47	1.00	74LS366/80LS96	0.75
74LS48	0.98		
74LS74	0.50	74LS367/80LS97	0.75
74LS75	0.68		
74LS76	0.50	74LS368/80LS98	0.75
74LS86	0.50		
74LS109	0.50	74LS386	0.55
74LS125	0.63	81LS95	1.13
74LS126	0.63	81LS96	1.13
74LS132	1.25	81LS97	1.13
74LS138	1.10	81LS98	1.13
74LS139	1.15		

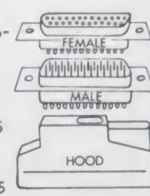
DB-25 CONNECTOR

CAVE grafix

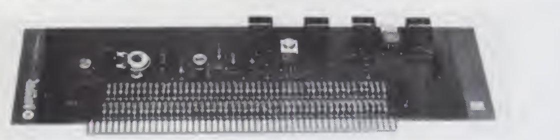
25 PIN RS-232 CONNECTORS: sub-mini D type.

Male plug with plastic hood, part #DB25P $3.95

Female jack, part #DB25S $3.95



EDGE CONNECTORS: #S-100-140ST Gold plated soldertail edge connector, 0.140" spacing for Altair Motherboards....**1/$6, 5/$27.50**
#S-100ST same but .250" row spacing for IMSAI.....**1/$5, 5/$22.00**
#S-100WW same but gold plated, 3 level wrap posts..**1/$5, 5/$22.00**



Active Terminator $29.50

Plugs into any S-100 Motherboard whose buss lacks active terminations. Cleans up noise, crosstalk, overshoot, and other buss problems that can scramble data unpredictably. Kit form only.

MOTHERBOARD

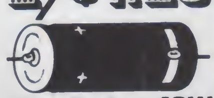
10 Slots $90 18 Slots $124

Includes **all** edge connectors, plus active terminations to minimize crosstalk, noise, overshoot, and ringing that may be present with unterminated busses. Excellent for stand alone system, or add to existing systems. Kit form only.

Music spoken here

Many of you are into making music with your computer; some people generate sounds within the machine itself, others use them to control synthesizer hardware. Where do we come in? One of our lines is the series of MusiKits™ designed by Craig Anderton, writer for Guitar Player, Popular Electronics, Contemporary Keyboard, and a bunch of others. MusiKits™ contain a circuit board, electronic components, and pots; user supplies case and hardware. There are 24 in all...some you might like are the **8 In, 1 Out Mixer (#18, $20)** which can mix up to 8 audio inputs to a common output; the **Super Tone Control (#17, $10.50)**, a low noise, state variable filter that gives high, low, and bandpass outputs; a **Reverb Unit (#22, $13.00** less springs**)** for adding concert hall sound and acoustic depth. Want to know more? Check our flyer.

SPECIAL 2/$1.25



10000 uF at 10V!

Building a 5V power supply? Need to beef up an existing supply that lacks sufficient capacitance? Here is the answer.

TERMS: Please allow up to 5% for shipping, more for Vector #VP2; excess refunded. Prices good through end of magazine cover month. Californians add tax. CODs accepted with street address. For BankAmericard®/VISA®/Mastercharge® orders ($15 min) call **415-562-0636**, 24 hours.

GODBOUT

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SEVERAL GOOD REASONS WHY YOU SHOULD HAVE OUR FLYER: 1) CMOS 2) LINEARS 3) MICROPROCESSORS 4) POWER SUPPLIES 5) RESISTORS 6) CAPACITORS 7) DISPLAYS 8) SOCKETS 9) VECTOR PRODUCTS 10) ENCLOSURES 11) ALL THE OTHER THINGS WE CAN'T FIT INTO THIS SPACE.

Now low-cost memory stacks up in reliability!

Introducing a new generation of ECONORAM* dynamics with SynchroFresh™ reliability

Meet ECONORAM* III with SynchroFresh™, the 8Kx8 dynamic memory for S-100 bus computers that really works. And uses less than half the power of static designs. And costs just $149 for an assembled 8K.

Unlike previous attempts at building a low-cost dynamic memory, ECONORAM* III is entirely reliable ... because of SynchroFresh™, a new approach to memory refresh that is simple, elegant and totally effective.

SynchroFresh™ was invented by George Morrow, designer of the original ECONORAM*. Instead of arbitrarily interrupting your CPU to perform memory refresh cycles, Morrow designed SynchroFresh™ to weave refresh invisibly into the natural timing of the S-100 bus. SynchroFresh™ circuitry simply monitors your computer's machine states, utilizing all of the normal opportunities for memory refresh. It's that simple.

And simplicity means reliability and dramatically lower cost. That's why a SynchroFresh™ design was chosen for the first ECONORAM* dynamic, to follow in the footsteps of the largest-selling static memories for personal computers.

ECONORAM* III with SynchroFresh™ is an 8Kx8 dynamic board, configured as two individually addressable 4K blocks for flexibility. It is available assembled, tested and warranteed for one full year for just $149. This unprecedented warrantee offers a full refund of purchase price if ECONORAM* III does not run reliably with your S-100 CPU—evidence of our confidence in its performance.

It is also available as a kit with complete assembly instructions and documentation for $159.

ECONORAM* III with SynchroFresh™, in assembled or kit form, may be ordered directly from Thinker-Toys™. Write 1201 10th Street, Berkeley CA 94710 or call (415) 527-7548. Call BAC/MC orders toll-free to 800-648-5311. Or ask your computer store to order it for you.

NEW LOW PRICE

$149

8K assembled, tested, warranteed 1 year

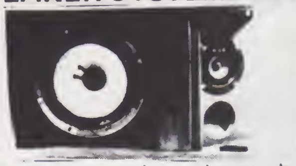
A product of Morrow's Micro-Stuff for

Thinker Toys™

*ECONORAM is a trademark of Godbout Electronics.

THIS AD MENTIONS ONLY A FEW OF THE THOUSANDS OF BARGAIN ITEMS AVAILABLE FROM THE GIANT B&F CATALOG. CIRCLE THE READER SERVICE CARD FOR OUR CATALOG!

SPEAKER SYSTEMS KIT

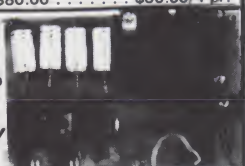


Fantastic air-suspension enclosures, designed for direct dispersion of high frequency tones and wide dispersion of the low tones. Size: 17" x 10½" x 9½"deep. Sold with 2 - 8" woofers; 2 - 4" dome tweeters; 2 crossover networks; grill cloth and instructions . . . all the components you'll need to build a pair of quality air-suspension systems! New, all U.S. made. Sh. Wt. 35 Lbs. .7ZU70242. $49.50/set

CABINETS ONLY . . .

Cabinets described above, less other components, sold in pairs.
Sh. Wt. 25 Lbs. .7OB70200. $25.00/pr.
4 pairs for $80.00 . . . . $80.00/4 pr.

LOGIC/ OP AMP POWER SUPPLY



Surplus from a computer phone. Power supply is regulated, input of 115V 60Hz., outputs of ±12V @ .125A, +5V @ .75A. Uses (3) 723 voltage regulator IC's for regulation. Open frame type, Qty. Ltd. Size: 7.2"L x 5.6"W x 2"H. New.
Sh. Wt. 5 Lbs. . . 7MI70353 . . .$13.50
3 for $38.88. . . 7MI70353 . . $38.88/3

TV—COMPUTER INTERFACE KIT

Converts any standard TV into a computer monitor. This self-contained RF oscillator & modulator allows easy interface of any video output device to a standard TV set. This kit was part of a video game, and contains its own power supply. With instructions & data.
Sh. Wt. 3 Lbs. . . .7ZU70213. . . $7.88
7 for $48.00. . . 7ZU70213 . . $48.00/7

I/O TERMINAL

At one time these data terminals were used by stock brokers for keeping track of stock quotations. They tied in to a central system which has now been updated, leaving these surplus units behind.

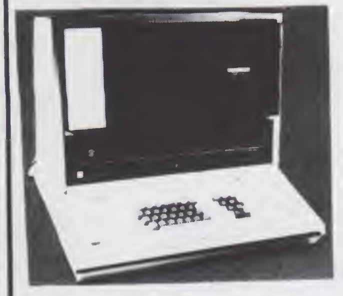
Use this unit as a basis for building your own computer input/output station or to build a compact scope . . . or simply take it apart for the components within.

Sold complete or in parts, prices and descriptions listed below:

† **3" CRT, with Hi-volt. supply** (+3315 vdc; –1730 vdc), and low-volt. supply +440V; +225V; +125V; +28V; +1.2V; +0.6V; 6.3VDC; 6.3VAC. Also - **ramp generator card** & some drive circuits (15 Lbs.) $17.50
† **50 key Block keyboard**, with diode matrix on 2 cards.(5 Lbs.) $12.50
† **Handsome desk-top, slope front case**, suitable for up to an 11" CRT, overall 10½w x16d x9"h,(10 Lbs.) $7.50
† **Plus:** 3 wire line cord, brown, 7'lg for $1.00; 14 wire connector cable for $2.50.
† **COMPLETE UNIT** Sh. Wt. 35 Lbs. 6NB60336 . . . .$29.95
† Also available is a **complete tech. manual** covering operating procedure, theory disassembly (& reassembly), troubleshooting techniques and schematics.
With complete unit - **$1.00** or sold separately for **$3.50** each. Sh. Wt. 8 oz.

WHEN ORDERING:
Specify part, use order no. 6NB60336

KEY-TO-MAGNETIC TAPE RECORDER



Singer/Pertec systems with display station, keyboard, 7 track magnetic dat recorder, controller, etc. Singer closes out its computer products division and these unit become surplus! Their loss ($460x10⁶) is your gain . . . you can buy this super recorder for pennies on a dollar. They are late design models of recent mfg., and are still being serviced with backup. Unit has internal memory/buffer for 80 or 200 character storage. Units show character, character no., and record no. Read back circuits allows search on record key, editing, duplicating, etc. Units were working when taken out of service and are complete & ready-to-go, but may require minor adjustments. Sold on an "AS IS" basis only. Manuals not supplied with unit, available separately. Size: 19"H x 21¼"W x 19½"D. Tape not supplied.

We have 2 types available:
Md. 4301-7 7-track Data Recorder, our catalog no. 7SF70296 . . . . $218.88
Complete Manual .7SF70296-M .$28.50
Md. 4311-7 7-track Data Recorder with remote data communication channel, our catalog no. 7SF70297 . . . . $248.88
Complete Manual .7SF70297-M .$28.50
(Manuals weigh 3 Lbs.)

All Magnetic Tape Data Recorders are shipped via truck, freight collect to you. Customer pays shipping.

Model 52 LINE PRINTER — $650.00

Computer surplus close-out on Singer-Friden Md. 52 line printer. 100 lines per minute with 132 characters per line max. The printer is connected to a system computer through an input/output channel and may be located up to 2,000 wire-feet from computer using a 2-wire line. Uses standard continuous paper forms, with up to 5 copies and 1 original. Power: 115V, 60 Hz; 6 amps. Size: 30"W x 27"Dp x 38"H.

These units were working & going units when taken out of service. Shipped only on an "AS IS" basis. You should be able to put these on line with a minimum of work, and then you have a $3,600 line printer working for you at less than 1/5 the cost. Shipped via truck freight collect to you, F.O.B. Peabody, Ma. 01960.
7SF70298 . . . . $650.00
DATA MANUALS, while they last . . .
7SF70298-M $45.00
**Also available are a few damaged units, which have broken glass covers. Damage appears to be cosmetics only. Save $100.
7SF70299 . . . . $550.00

Singer-Friden
Md. 52 Line Printer

EMPLOYEE ENTRANCE CHECK STATION

This unique system for verification of entering employees is made up of modular components, each of which is useful separately. You can buy just the part you need, or purchase an entire system for your own uses and/or education. Capable of tie-in to an external printer. Size: 20½"W x 23" x 6½".

The system contains the following modular sections:
A. Badge Reader with power supply, Holther coded - but comes out ASC11. Input 110 V, 60 Hz. Sh. Wt. 15 Lbs.
7SF70295-A. $25.00
B. Modular Power Supply O.F. +5V, 3A; ±12V, .25A; +24V, .5A. 10 Lbs.
7SF70295-B $19.50
C. Modular Memory Stack, with drivers etc. 512 x 6, requires 24V input. 5 Lbs.
7SF70295-C $17.50
D. Central Processor for above memory, 5 Lbs. . . . . 7SF70295-D $25.00
E. Hi Voltage Power Supply for plasma display (below) 5 Lbs.
7SF70295-E $10.00
F. 4 Digit Display on front panel 3 Lbs.
7SF70295-F $10.00
G. Time Clock for badge reader, etc.
5 Lbs. . . . . . 7SF70295-G $10.00
H. Key Switch SPST 8 oz.
7SF70295-H. $2.00
J. Complete Unit (Used)*
7SF70295-J $69.88
K. Complete Unit (New)*
7SF70295-K. $88.50
* Complete units weigh in excess of 75 pounds and must be shipped via truck freight collect to you.

OTHER SINGER/FRIDEN MACHINES ARE AVAILABLE — SEND FOR CATALOG!

TOUCH-TONE GENERATOR CHIP

New, 2 of 8 encoder chip ME8900, (similar to the MC14410). Sold with data sheet on uses of MC14410 chip. No crystals required. Sh. Wt. 8 oz.
7VL70160 . . . $6.95 ea. . . $60.00 for 10

POSTAGE: Please add sufficient funds for postage and insurance. Shipping weight for merchandise is listed at the end of each product description. All shipping is from Peabody, Ma. 01960.
Mass. Residents Add 5% Sales Tax.
SEND FOR OUR FREE CATALOG!
Or, receive our catalog in an order and insure yourself of a place on our mailing list

PHONE ORDERS WELCOME!
Bank Americard, Master Charge and American Express Accepted.
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$10.00 Minimum on Charge Orders

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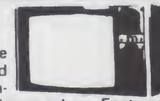
COLOR TV
Chassis & Parts



New solid state color TV chassis and parts for use with In-Line black matrix picture tubes. Features include one button color tuning AFC and low power consumption.

We have two chassis types, the TS951 (for 13 & 15") and the TS953 (for 19").

To build a complete 19" TV these parts must be added: UHF & VHF tuners, picture tube, tube shield, purity magnets, antenna, yoke, speaker, on-off switch, 4-10K pots, binding posts & case. To build a 13" or 15" TV you'll have to add: picture tube, tube shield, yoke, purity magnets, antenna, 2nd stage hi-voltage boost, binding posts & case (chassis has tuners).

We do not offer a complete parts package, but we do include full tech. training manual, and we have some parts available. These chassis are new & guarenteed.

Price List Sh. Wt. 12 Lbs. each.
13" TV Chassis (w/tuners & controls)
6Z60175 . . . . $49.50
15" TV Chassis (w/tuners & controls)
6Z60174 . . . . $49.50
19" TV Chassis (no tuners, no controls),
6Z60172 . . . . $29.50
VHF Tuner (for 19"). .6Z60303. . $8.50
UHF Tuner (for 19"). .6Z60304 . . $2.50
Antenna Telescope . .5MI00419 . . $1.50
Binding Post Ass'y. . 4MI00422 . . $1.50

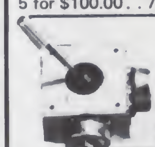
ALSO . . . .

We have found some of the same model "TV" chassis that have been damaged, most with bent frames or cracked P.C. boards. They are sold "AS IS", at low, low prices. Parts are worth 5X as much. All sales final. Sh. Wt. 12 Lbs. each.
13" Chassis . . . 7DZ70059 . . . . $22.50
15" Chassis . . . 7DZ70060 . . . . $22.50
17" Chassis . . . 7DZ70061 . . . . $14.88
19" Chassis . . . 7DZ70062 . . . . $14.88

4 in 1 TV GAME with JOYSTICK CONTROLS

Hockey-Soccer/Novice-Expert. Features a hockey mode in which players skate up, down and accross the ice using the joystick, with the ability to "catch" the puck and "shoot" for goals with another control. A real challenge for all players. LED readouts show score, operates on 115V 60Hz. Never at this low price!
Sh. Wt. 5 Lbs. . . 7HU70284 . . . $22.50
5 for $100.00. . 7HU70284 . .$100.00/5

JOYSTICKS Two 10K POT'S



Super for X-Y functions: audio, computer, remote control, graphics, etc. Sh. Wt. 8 oz.
7J70163 . . . . . . $4.95

Joystick: Four 100K Pot's; by ALPS
The best controls on the market. . . 8 oz.
7J70293 . . . . $5.95 ea

AUTOMATIC PHONE DIALER

Stores up to 38 phone numbers!

"THE NAME CALLER"

Here's a neat item, brand new and packaged surplus. Great for business, home, baby sitters, people confined to beds, emergencies . . . or just as a convenience. Keep all your most-often-called numbers in memory at all times. Two models available: Home 2001 and Business 3001, (Business 3001 has 50 pin connector for multi-line phones). Sh. Wt. 12 Lbs.
Home 2001 . . . .7ZU70265 . . . . $28.88
Business 3001. . . 7ZU70266 . . . $38.88

B&F

B4

RONDURE COMPANY

2522 BUTLER ST. • DALLAS, TEXAS 75235 • 214-630-4621

the computer room

Specifications
- Size: 21" wide x 21" deep x 8" high
- Power Input 115 Volt 60 Hz
- Interface: RS232
- Weight: 54 lbs. (Shipping Weight 65 lbs.)
- 15" Carriage
- Input/Output rates to 15 characters per second
- EBCD Code
- Half Duplex
- 132 Print Positions, 10 Pitch
- Can be used off-line

Used
Working
(Non Refurbed) $695.
Used
Working
(Refurbed) $895.
Software to connect ASCII Output of 8080 Class Processor to Selectric: Code $25
Manufacturers Electronic & Mechanical Documentation
$20. with machine $40. Documentation only

SELECTRIC TERMINAL (IBM Selectric Mechanism, Heavy Duty, Datel Electronics)

CARTERFONE MODEL 318 ASYNCH MODEM

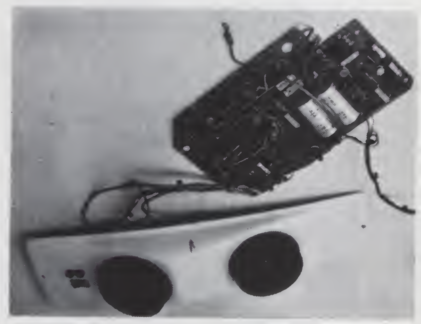
- HARD WIRE
- TTY OR RS-232B INTERFACE
- ORIGINATE ONLY
- UP TO 300 BPS

USED – UNTESTED . . $25.00
USED – TESTED $80.00

We ship prints with these.

CF328 Acoustic version of same unit.

USED – UNTESTED . . . $25.00
USED – TESTED $80.00

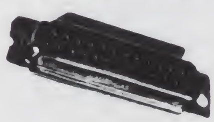


NOVATION ACOUSTICAL MODEM

Originate Only
Used – Untested
Physically fit into Model 33 Teletype.
Manufactured by Novation

$25 each

CANNON 25 PIN CONNECTOR



ITEM C-1

RS232
Male Connector *NEW* $2.50 Each
Solder Type Cover $1.00 Each

DEC LSI-11 COMPONENTS

All Items NEW

ORDER BY PART NUMBER

		List	Selling Price
CPU	(KDIIF)	$990	$795
SIO	(DLVII)	235	210
Card Cage	(H9270)	175	155
4K RAM	(MSVIIB)	625	550

Write for our CATALOG of many parts, terminals, printers, etc

SUGART MINI-FLOPPY DRIVE

NEW PRICE
$355.00 Each
~~$390.00 each~~

MODEL SA-400

SHIPPING INFORMATION:

Modems: $2.00 each; 2 for $4.00 UPS
Small Items & Parts: $2.00/order less than $20.00; $4.00/order $20.00 to $100.00; $6.00/order over $100.00
Large Items & Parts: Specify Freight or Air Freight Collect
Foreign Orders: Add appropriate freight or postage
Please specify exactly what you wish by order number or name or both.
We now take Master Charge orders. Specify full number, bank number and expiration date.

ORDERING INFORMATION:

All items subject to availability. Your money returned if we are out of stock.
Items are either new (specified) or they are used (tested or untested) and no other warranty is made or implied.

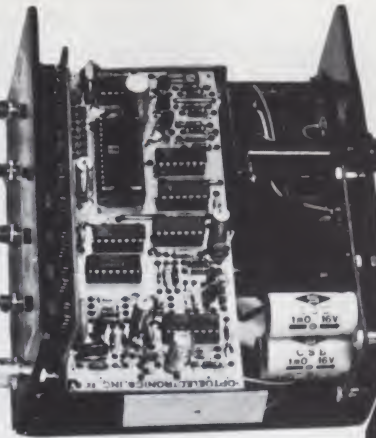
In general no cords or cables are shipped unless we specify that they are supplied.
We ship the same day we receive a certified check or money order.
Texas residents add 5% sales tax.
Please call if you have a question.

RONDURE COMPANY R7
2522 BUTLER
DALLAS, TEXAS 75235
PHONE: (214) 630-4621

NEW LSI TECHNOLOGY

FREQUENCY COUNTER

TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION [PORTABLE BATTERY OPERATION IS NOW PRACTICAL], DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!



$119.95 COMPLETE!

KIT #FC-50 C .... 60 MHZ COUNTER WITH CABINET & P.S. ......
KIT #PSL-650 .... 650 MHZ PRESCALER [NOT SHOWN] 29.95
MODEL #FC-50WT .... 60 MHZ COUNTER WIRED, TESTED & CAL. 165.95
MODEL #FC-50/600 WT .. 600 MHZ COUNTER WIRED, TESTED & CAL. 199.95

SIZE:
3" High
6" Wide
5½" Deep

FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
PRESCALER WILL FIT INSIDE COUNTER CABINET
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [± .0001%]; AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5 V DC REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED.

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

CABINET I
3"H, 6¼"W, 5½"D
CABINET II
2½"H, 5"W, 4"D

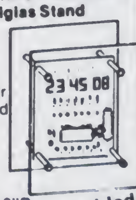
Black, White or Clear Cover

$6.50 ea.

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" 95¢ ea. 4/$3

SEE THE WORKS Clock Kit
Clear Plexiglas Stand

- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included



Plexiglas is Pre-cut & drilled

Kit #850-4 CP

Size: 6"H, 4½"W, 3"D

$23.50 ea. 2/$45. Assembled $29.95

60 HZ. XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC.
1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM

#TB-1 (Adjustable)
Complete Kit $4.95
Wir & Cal $9.95

SPECIAL PRICING!

PRIME - HIGH SPEED RAM

21L02-3 400 NS

LOW POWER - FACTORY FRESH

1-24	$1.75 ea.	100-199	$1.45 ea.
25-99	1.60 ea.	200-999	1.39 ea.

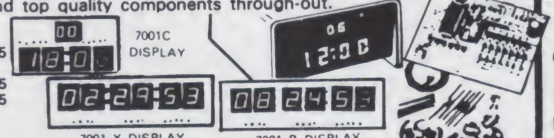
1000 AND OVER $1.29 ea.

6-DIGIT LED CLOCK CALENDAR KIT
DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.

KIT - 7001B WITH 6 - .5" DIGITS $39.95
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
KIT - 7001X WITH 6 - .6" DIGITS $45.95



KITS ARE COMPLETE (LESS CABINET)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT # TB-1

JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer, Line Cord, Switches and all Parts. Ideal Fit in Cabinet II

Kit #5314-5 $19.95 2/$38.

JUMBO DIGIT CONVERSTION KIT $9.95 ea.

Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.
Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.

Specify for 7001
B, C or X - $7.95

MOBILE LED CLOCK

12/24 HR .4" DIGITS!

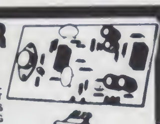
MODEL #2001
12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off in Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT $27.95 EA. 3 OR MORE $25.95 ea. 115 VAC Power Pack #AC-1 $2.50 EA.

ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] $37.95 EA 3 OR MORE $35.95 ea.
Wired for 12-Hr. Op. if not otherwise specified.

AUTO BURGLAR ALARM KIT



AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND KEYLESS ALARM HAS PROVISION FOR POS & GROUNDING SWITCHES OR SENSORS WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED CMOS RELIABILITY RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS OR AVAILABLE WIRED AND TESTED

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANS-FORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

OPTOELECTRONICS, INC.

BOX 219 HOLLYWOOD, FLA. 33022
PHONE [305] 921-2056 / 921-4425 O3

ORDER BY PHONE OR MAIL
COD ORDERS WELCOME

ORDERS TO USA & CANADA ADD 5% FOR SHIPPING, HANDLING & INSURANCE. ALL OTHERS ADD 10%. ADDITIONAL $1.00 CHARGE FOR ORDERS UNDER $15.00 - COD FEE $1.00. FLA. RES. ADD 4% STATE TAX.

master charge
BANKAMERICARD
welcome here

master charge

MICROCOMPUTER

your BANKAMERICARD welcome

8080A SUPPORT DEVICES

8212	4.00
8214	12.95
8216	5.25
8224	6.00
8228	9.25
8238	8.20
8251	12.00
8253	28.00
8255	12.00
8257	22.00
8259	22.00

6800 SUPPORT

6810P	6.00
6820P	8.00
6828P	9.60
6834P	21.95
6850P	12.00
6852P	17.00
6860P	15.00
6862P	18.00
6880P	2.70

Z80 SUPPORT DEVICES

3881	15.95
3882	15.95

F-8 SUPPORT DEVICES

3851	14.95
3852	14.95

FLOPPY DISC CONTROLLER

PD372D	65.00
1771	69.95

DYNAMIC RAMS

414D (16P)	5.50
1103 (16P)	1.50
2104 (16P)	6.50
2107B (22P)	4.50
2107B-4 (22P)	4.00
TMS4050 (18P)	4.50
TMS4060 (22P)	4.50
4096 (16P)	5.50
MM5262 (22P)	3.00
MM5270 (18P)	5.00
MM5280 (22P)	6.00

STATIC RAMS

31L01	2.00
91L11A	4.25
91L12A	4.25
1101A	1.00
2101	3.00
2102 (10S)	1.25
2102-1 (5.00NS)	1.50
2M1A-4	4.45
2112A-4	3.00
2501B	1.45
3107	2.95
*4200A (250NS)	13.75
410D (200NS)	11.95
*4804	20.00
5101	20.00
74C89	3.00
74S201	4.75
91L02A	2.00
7489	2.25
8225	1.50
8599	1.50
82S09	9.00

*Limited supply.

MISC OTHER COMPONENTS

NH0025CN	1.75
NH0026CN	3.00
N8T20	4.00
N826	3.25
N8T97	1.45
74367	1.00
DM8098	1.00
1488	1.95
1489	1.95
3205	6.20
D-3207A	2.50
C-3404	3.95
P-3408A	6.75
P-4201	4.95
MM-5320	7.50
MM-5369	2.00
DM-8130	3.00
DM-8131	2.50
DM-8831	2.50
DM-8833	2.50
DM-8835	2.50
SN74LS367	1.00
SN74LS368	1.00

MICROPROCESSOR'S

F-8	19.95
Z-80	36.95
Z-80A	49.95
CDP1802DC	29.50
AM2901	22.95
6502	24.95
6800	24.95
8008-1	8.75
8080A	15.95
8080B	16.95

SHIFT REGISTERS DYNAMIC

1404AN	3.00
2405	4.95
2505K	3.00

SHIFT REGISTERS STATIC

MM506	.89
2509K	1.00
2518B	3.95
2533V	2.00
TMS3002	1.00
TMS3112	3.95
MM5058	2.00

FIFO

3341A	6.75
2812-D	11.95

KEYBOARD CHIPS

AY5-2376	14.95
AY5-3600	14.95

TV GAME CHIPS

TMS 1955 (6 Games)	10.95
AYSS-8500 (6 Games)	10.95

USRT

S-2350	13.50
IM-6403	10.80
TMS-6011 (TI)	6.25
TR-1602A (WD)	6.25

UARTS

AY5-1013	6.75
AY5-1014A	9.95

CHARACTER GENERATORS

2513	6.75
2513	6.75
3257	18.00
MCM6571	10.80
MCM6571A	10.80
MCM6572	10.80
MCM6581	8.75

WAVEFORM GENERATOR

8038	4.50
MC4024	2.75
566	2.00

PROM'S

1702A	5.00	5204AQ	10.00
1702AL	7.00	6834	21.95
2704	20.00	6834-1	16.95
2708	24.00	82S23B	4.00
2716	75.00	82S129B	4.25
3601	4.50	8223B	4.00
5203AQ	7.00		

IMSAI/ALTAIR **S-100** COMPATIBLE

JADE Z80 KIT

—with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

$135.00 EA.

JADE CO

Electronics for the Hobbyist and Experimenter

5351 WEST 144th STREET
LAWNDALE, CALIFORNIA 90260
(213) 679-3313

Discounts available at OEM quantities. Add $1.25 for shipping. California residents add 6% sales tax.

Assembled & Tested

8K STATIC RAM BOARD

250ns.	$209.95
350ns.	$199.95
450ns.	$189.95

- * WILL WORK WITH NO FRONT PANEL
- * FULL DOCUMENTATION
- * FULLY BUFFERED
- * S100 DESIGN
- * ADEQUATELY BYPASSED
- * LOW POWER SCHOTTKY SUPPORT IC'S

KIT

250ns.	$169.95
350ns.	$149.95
450ns.	$139.95

J6

CRYSTALS

THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33/U	$5.95
CY2A	2.000 MHz	HC33/U	$5.95
CY2.01	2.010 MHz	HC33/U	$1.95
CY3A	4.000 MHz	HC18/U	$4.95
CY7A	5.000 MHz	HC18/U	$4.95
CY12A	10.000 MHz	HC18/U	$4.95
CY14A	14.31818 MHz	HC18U	$4.95
CY19A	18.000 MHz	HC18/U	$4.95
CY22A	20.000 MHz	HC18/U	$4.95
CY30B	32.000 MHz	HC18/U	$4.95

EXAR

XR-2206KB Kit $19.95 — XR-2206KA Kit $14.95

WAVEFORM GENERATORS

XR-205	$8.40
XR-2206CP	4.49
XR-2207CP	3.85

STEREO DECODERS

XR-1310CP	$3.20
XR-1310EP	3.20
XR-1800P	3.20
XR-2567	2.99

MISCELLANEOUS

XR-2211CP	$6.70
XR-4136	99
XR-1468	3.85
XR-1488	5.80
XR-1489	4.80
XR-2208	5.20

TIMERS

XR-555CP	$ .49
XR-320P	1.55
XR-556CP	1.85
XR-2556CP	3.20
XR-2240CP	3.25

PHASE LOCKED LOOPS

XR-210	5.20
XR-215	6.60
XR-567CP	1.95
XR-567CT	1.70

CONNECTORS

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out

Bifurcated Contacts — Fits .054 to .070 P.C. Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100	PINS (Wire Wrap)	$6.95
50/100A (.100 Spacing)	PINS (Wire Wrap)	$6.95

25 PIN-D SUBMINATURE

DB25P	PLUG	$3.25
DB25S	SOCKET	$4.95

HEAT SINKS

205-CB — 680-.75A

205-CB	Beryllium Copper w-black finish for T0-5	$ .25
291-.36H	Aluminum for T0-220 Transistors & Regulators	$ .25
680-.75A	Black Anodized Aluminum for T0-3	$1.60
401-A	Black Anodized Aluminum — predrilled mounting holes for T0-3 — 4¾ x 1¼ x 2"	$1.75

DIP SWITCHES
SPST Slide Action

- #206-4 (8 pin dip) 4 switch unit $1.75 ea.
- #206-7 (14 pin dip) 7 switch unit $1.95 ea.
- #206-8 (16 pin dip) 8 switch unit $2.25 ea.

Etching Kits (cannot be shipped via air)

32 X A-1	P C Etch Materials Kit enough for 5 circuit boards	$29.95 ea.
27 X A-1	Etched Circuit Kit Complete kit — only add water	$ 9.95 ea.

Plugboards

3662	6 5 X 4 5 X 1/16 Epoxy glass P-Pattern-44 P C Tabs-spaced 156	$ 6.95 ea.
22/44	Mating connector for plugboard — 22 pin double readout	$ 2.95 ea.
8800V	Universal Microcomputer/Processor plugboard — Epoxy Glass — complete with heatsink and mounting hardware 5 313 x 10 x 1/16 copper clad	$19.95 ea.

Vector

1/16 VECTOR BOARD

0.1" Hole Spacing

	Part No	P-Pattern L	W	Price 1	2-Up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062	4.50	6.50	2.07	1.86
	84P44 062	4.50	8.50	2.56	2.31
	169P44 062	4.50	17.00	5.04	4.53
	169P84 062	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062C1	4.50	17.00	6.80	6.12

Vector

SLIT-N-WRAP WIRE WRAP TOOL

- Slits and opens insulation exposing bare wire
- No pre-cutting or pre-stripping.
- Comes complete with two - 100 ft spools #28 AWG wire

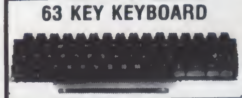
Model P180 $24.50

HEXADECIMAL ENCODER 19-KEY PAD

- 1 — 0
- ABCDEF
- Return Key
- Optional Key (Period)
- — Key

$10.95 each

63 KEY KEYBOARD $24.95



This keyboard features 63 unencoded SPST keys unattached to any kind of P C B. A very solid molded plastic 13" x 4" base suits most applications

H00165 16 LINE TO FOUR BIT PARALLEL KEYBOARD ENCODER CHIP $7.95

TOOLS

A97MS	— Diagonal Cutter - 4" semi-flush cut	$8.50 ea.
A11DMS	— Chain Nose Pliers - 4¾" long	7.50 ea.
T-6	— Wire Stripper - #16 to #26 gauge	3.75 ea.
55B	— Wire Stripper - #10 to #20 gauge	2.50 ea.
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8212	8 Bit Input/Output	4.95
8214	Priority Interrupt Control	15.95
8216	Bi-Directional Bus Driver	6.95
8224	Clock Generator/Driver	10.95
CDP1802		19.95
8228	System Controller - Bus Driver	$10.95
MC6800	8 Bit MPU	22.50
MC6820	Periph. Interface Adapter	10.00
MC6810AP1	128 x 8 Static RAM	7.95
MC6830L8	1024 x 8 Bit ROM	15.00
Z80	CPU	39.95

CPU'S

8080	Super 8008	24.95
8080A	Super 8008	16.00
2650	8 BIT MPU	26.50
P8085	CPU	29.95

SR'S

2504	1024 Dynamic	$ 3.95
2518	Hex 32 BIT	7.00
2519	Hex 40 BIT	4.00
2524	512 Dynamic	2.49
2525	1024 Dynamic	3.00
2527	Dual 256 BIT	3.95
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2533	1024 Static	5.95
3341	Fifo	6.95
74LS670	16 x 4 Reg	3.95

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AY-5-1013	30K Baud	$5.95

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2513(2140)	Char Gen -upper case	$ 9.95
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1101	256 x 1	Static	$ 1.49
2101	256 x 4	Static	5.95
2102	1024 x 1	Static	1.75
2107 5280	4096 x 1	Dynamic	4.95
2111	256 x 4	Static	6.95
7489	16 x 4	Static	2.49
8101	256 x 4	Static	5.95
8111	256 x 4	Static	6.95
8599	16 x 4	Static	3.49
91L02	1024 x 1	Static	2.25
74200	256 x 1	Static	6.95
93421	256 x 1	Static	2.95
MM5262	2K x 1	Dynamic	2 for 1.00

PROMS

1702A	2048	Famos	$ 9.95
5203	2048	Famos	14.95
82S23	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	5.00
74S287	1024	Static	7.95
3601	256 x 4	Fast	3.95
2708	8K	Eprom	19.95
2716	16K	Eorom	34.95
6301-1	1024	Tri-State Bipolar	3.49
6330-1	256	Open Collector Bipolar	2.95

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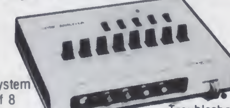
Logic Analyzer Kit

MODEL 100A $229.00/Kit



- Analyzes any type of digital system
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- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
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- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

Some applications are:

— Troubleshooting microprocessor address, instruction, and data flow
— Examine contents of ROMS
— Tracing operation of control logic
— Checking counter and shift register operation
— Monitoring I/O sequences
— Verifying proper system operations during testing

PARATRONICS TRIGGER EXPANDER - Model 10

Adds 16 additional bits. Provides digital delay and qualification of input clock and 24-bit trigger word. — Connects direct to Model 100A for integrated unit). **Model 10 — $229.00** Baseplate — $6.95

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- DM2 - Function Generator $74.95
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MAX-100 FREQUENCY COUNTER 20 MHz-100 MHz — 8 digit — .6" LED $134.95

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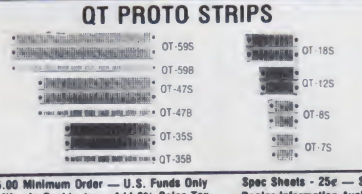
QT PROTO STRIPS



QT type	# holes	price
QT-59S	590	12.50
QT-59B	bus strip	2.50
QT-47S	470	10.00
QT-47B	bus strip	2.25
QT-35S	350	8.50
QT-35B	bus strip	2.00
QT-18S	180	4.75
QT-12S	120	3.75
QT-8S	80	3.25
QT-7S	70	3.00

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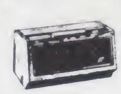

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Model KB500 DPM Kit $49.00
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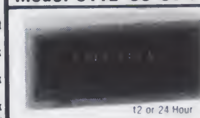
JE700 CLOCK



The JE700 is a low cost digital clock but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout and the MM5314 clock chip

12 or 24 Hour

115 VAC

KIT ONLY **$17.95**

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Injection molded unit. Complete with red bezal. 4½" x 4" x 1-9/16".

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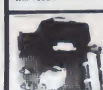
JE803 PROBE

The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL DTL RTL CMOS. It derives the power it needs to operate directly off of the circuit under test drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols (HI) 1 (LOW) 0 (PULSE) P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result

$9.95 Per Kit

printed circuit board



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STOCK NO.5554 POWER SUPPLY $34.50 ea. 2/65.00

EKG STRIP CHART RECORDERS

In our effort to provide the latest and best in electronic surplus, we have many times come up with unusual items. This time we hit the jack pot. We have acquired a limited number of STRIP CHART RECORDERS. originaly made to make Electrocard-iagrams. This is the HOT STYLUS type, that records on standard EKG paper. The unit is complete in that the input amplifier is encapsulated in the galvanometer. These instruments meet the demand-ing requirements of the American Heart Association for frequency response, sensitivity and linearity. The one we have, Model 103, normaly comes with a single channel, however, the ones we have include an event marker, which is a second hot stylus, which records time, by marking the tape when impulsed. These recorders were made by ASTRO-MED, a major supplier of strip chart recorders to the Medical Electronics Industry. The recorder has 2 speeds, 25 and 50 mm per sec. All that is need to put this recorder in operation, is the control circuitry, which consists of 3 pots and a switch. We provide the circuit diagram of the control circuitry. These recorders, are current merchandise, and the OEM price is plus $23.00 for the Event Marker option

STOCK NO. 5559K STRIP CHART RECORDER, with EVENT MARKER $75.00 ea.

DATEL ANALOG/DIGITAL & DIGITAL/ANALOG CONVERTERS

DATEL Model 898B, ANALOG to DIGITAL CONVERTER, is an 8 bit A/D converter, using the counter method of conversion. Analog input range is 0 to 10 volts, or $\pm$5 volts. Input impedance is 4.25 K Ohms. Parallel output, (8 parallel lines) held until next conversion command. Coding, 8 binary bits. Resolution, 8 bits (i part in 256). Power supply requirements, $\pm$15 volts and + 5 volts. This converter is currently being sold by the manufacturer for $69.00

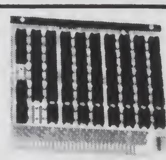
STOCK NO.5556K A/D converter DATEL Mod. 898B with data $28.75 2/54.00

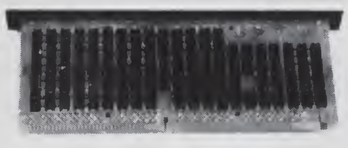
DIGITAL to ANALOG CONVERTERS, DATEL Mod. No. 198 and 298. Resolution, 8 binary bits, or 2 digit BCD. Input, DTL or TTL compatible. Positive logic. Update rate 5 Mhz. typical. Output $\pm$0.2% of Full Scale. (Can be adjusted to greater accuracy). Model 198 output is either current or voltage. Model 298 output voltage only. Output voltage 0 to 10 volts@ 5 ma. or $\pm$5 volts @ 5 ma. Output settling time, Model 198, 20 usec. Model 298 5 usec. Power requirements, $\pm$15 volts @ 15 ma. Size.2"x2"x .375" Present factory prices Model 198, $29.00; Model 298 $39.00. Comes with application data and notes.

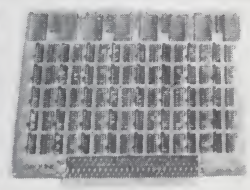
STOCK NO.5557K DATEL MODEL 198 D/A converter $12.95 2/24.00

STOCK NO.5558KDATEL Model 298 D/A converter $18.95 2/36.00

WIRE WRAP PROTOTYPE BOARDS







WIRE WRAP boards are ideal for developing new circuits, or using in place of a printed circuit board where making one board is not practical. Up to now however, the cost of these boards has been prohib-itive, with small boards running about $75.00, and larger boards running to almost $300.00. We have acquired a substantial number of boards, with prices more in line with prices hobbyists and experimenters can afford. 2 of the 3 different boards we have. have been removed from equipment, and the original wiring must be removed, which is a simple job with the inexpensive wire wrapping tools available today. The third board is a new board and is ready for immediate use.

Board 6559K contains 40 to 50 sockets, both 14 pin and 16 pin. There is space on the board should you need more. Board measures 6"x6¼", has Vcc and Ground planes. Has 70 (double 35) gold plated edge contacts.

Board 6558K is identical to 6559K above, except that it has 75 to 100 sockets, and2 sets of double 35 gold plated edge contacts.

Board 6592K is the new board, and has 40 sockets for either 14 or 16 pin ICs. It also has 4 LSI sockets (24 pins). If the LSI sockets are not used, they may be used for 4 additional ICs. All wire wrap pins are brought out to the top of the board for ease in wiring. Board has Vcc and Ground planes, and is made of G10 Fiberglas, an is 7¾"x8". Has standard 100 pin contacts.

STOCK NO.6559K 40 to 50 socket board $11.75 ea. 2/22.00
STOCK NO.6558K 75 to 100 Socket board $18.75 ea 2/36.00
STOCK NO.6592K 40 socket board(new) $24.50 ea. 2/47.00

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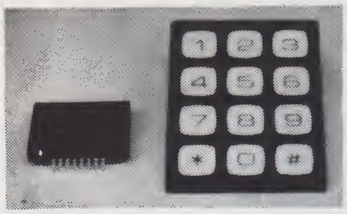

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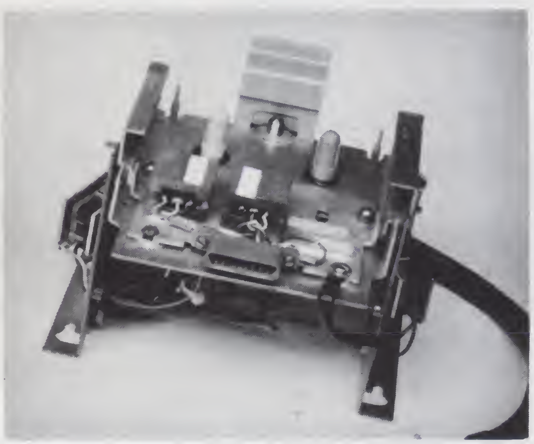

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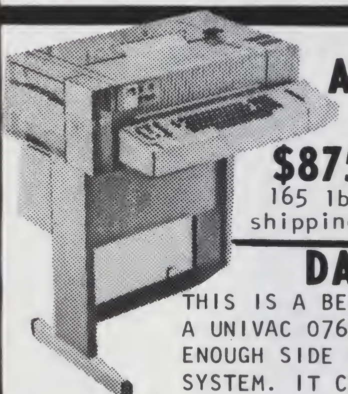

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$150 + $25 SHIPPING/HANDLING

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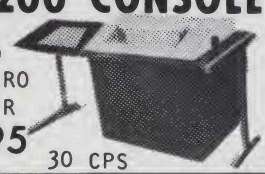

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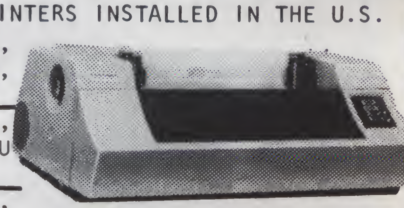

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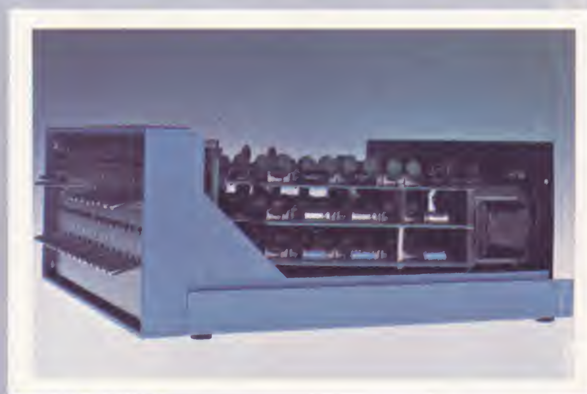

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